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Mizuno et al.

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(54) **AUTOMATIC HEAD CARE DEVICE AND AUTOMATIC HEAD CARE METHOD**

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A45D 19/10	(2006.01)
A61H 7/00	(2006.01)
A61H 15/00	(2006.01)
A61H 35/00	(2006.01)

(52) **U.S. Cl.**
CPC ***A45D 19/14*** (2013.01); ***A45D 19/08*** (2013.01); ***A45D 19/10*** (2013.01); ***A61H 7/004*** (2013.01); ***A61H 15/0078*** (2013.01); ***A61H 35/008*** (2013.01); *A61H 2201/0192* (2013.01); *A61H 2201/1215* (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC A45D 19/10
USPC 4/515–523
See application file for complete search history.

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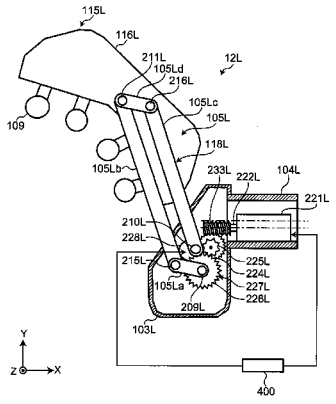
(57) **ABSTRACT**

An automatic head care device includes independently rotated first rotational driving shaft and second rotational driving shaft, a first link having one end fixed to the first rotational driving shaft, a second link having one end rotatably connected to another end of the first link, a third link having one end fixed to the second rotational driving shaft, a fourth link having one end rotatably connected to another end of the third link, a working shaft rotatably connecting another end of the second link to another end of the fourth link, a working body caring the person's head, the working body being rotatably supported by the working shaft, and a control unit controlling rotation of the first rotational driving shaft and the second rotational driving shaft.

16 Claims, 20 Drawing Sheets



(52) **U.S. Cl.**
CPC *A61H 2201/1463* (2013.01); *A61H 2201/1607* (2013.01); *A61H 2201/1671* (2013.01); *A61H 2201/1676* (2013.01); *A61H 2201/1692* (2013.01); *A61H 2201/5007* (2013.01)

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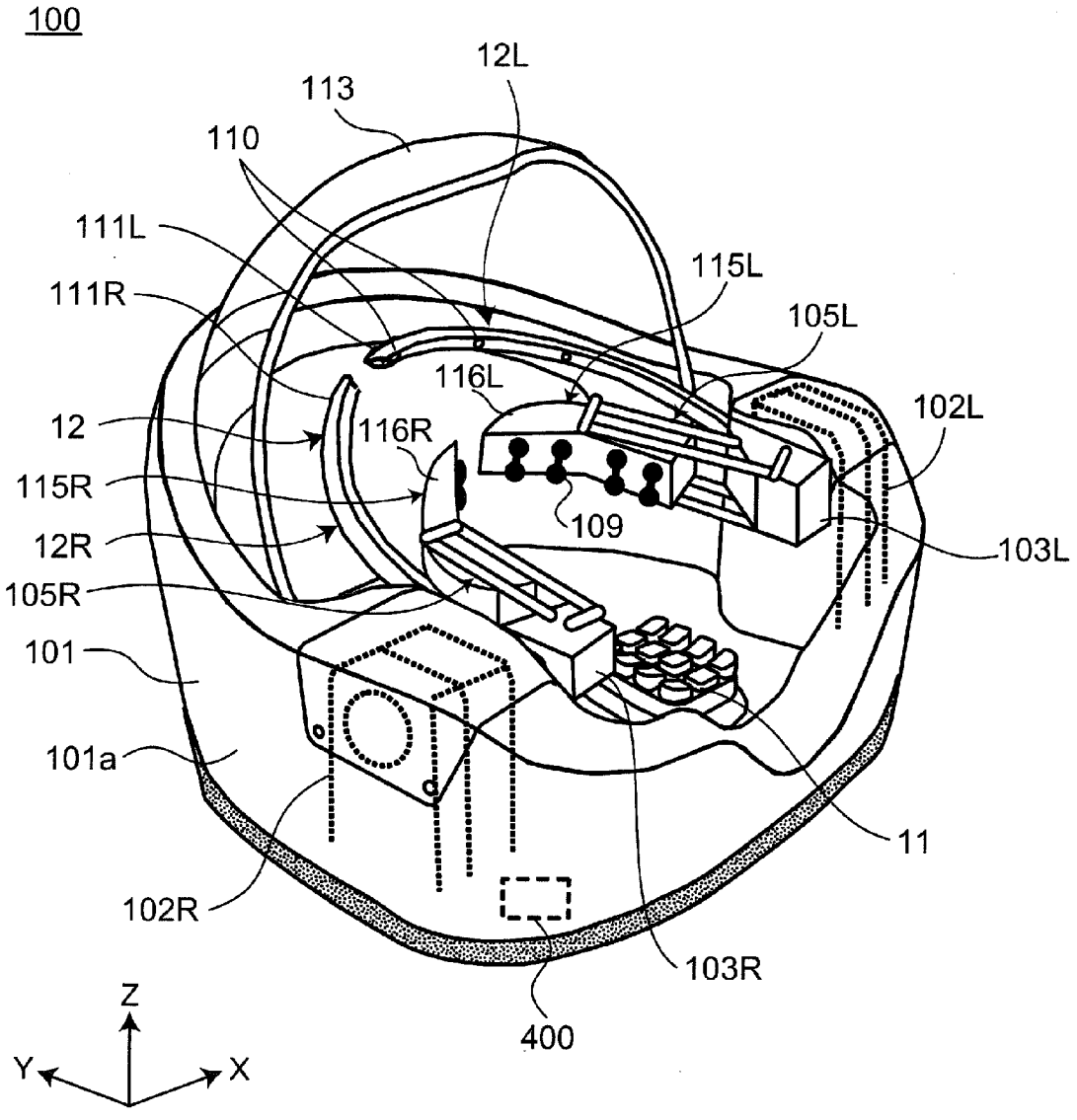
Fig.1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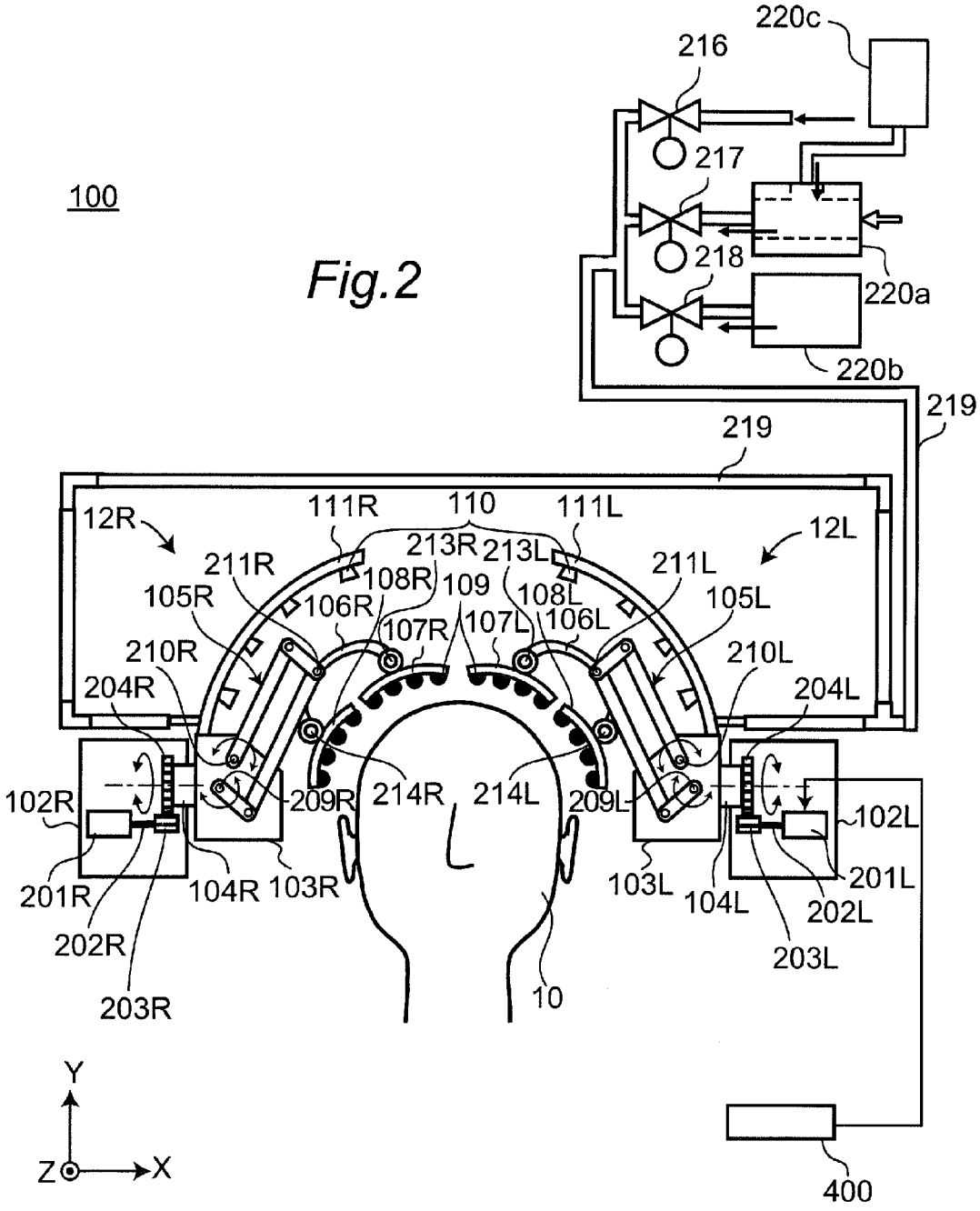
X

Fig.2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109
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209L
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Fig.3

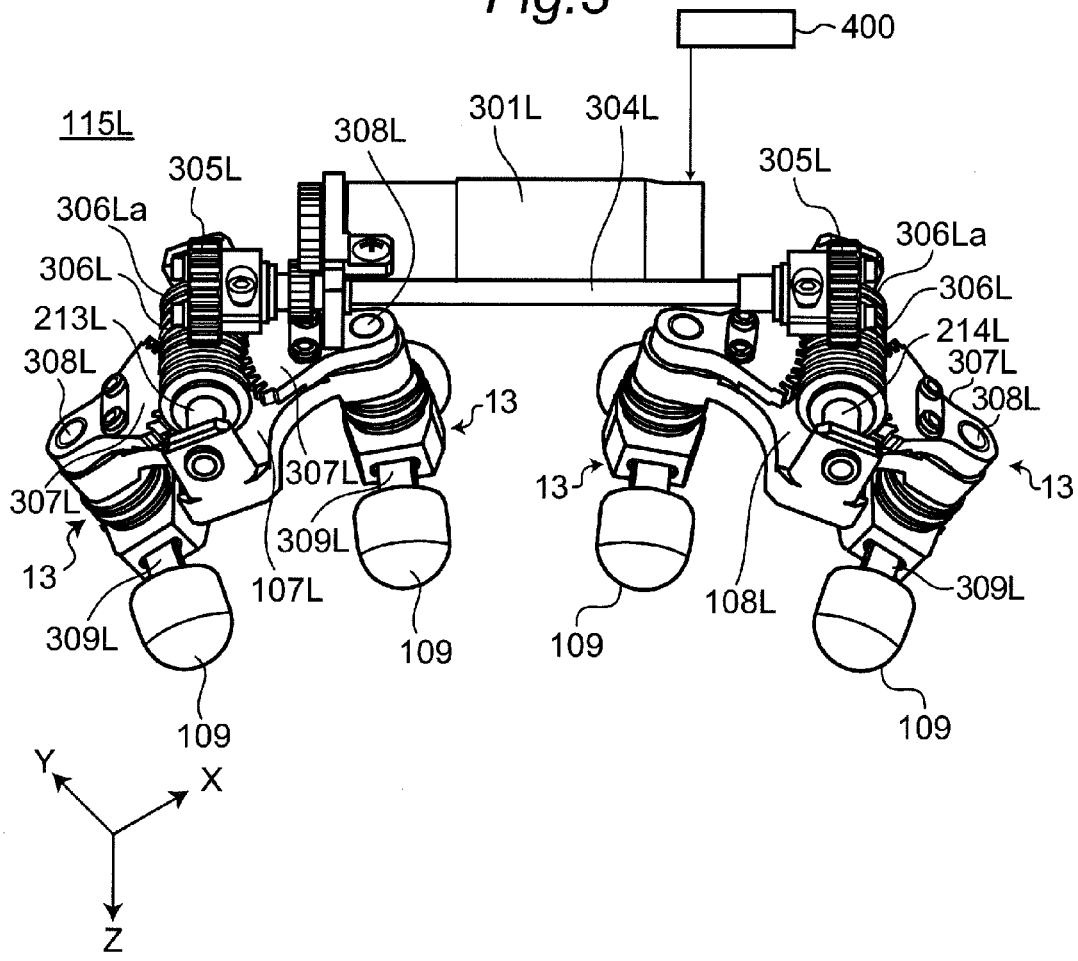
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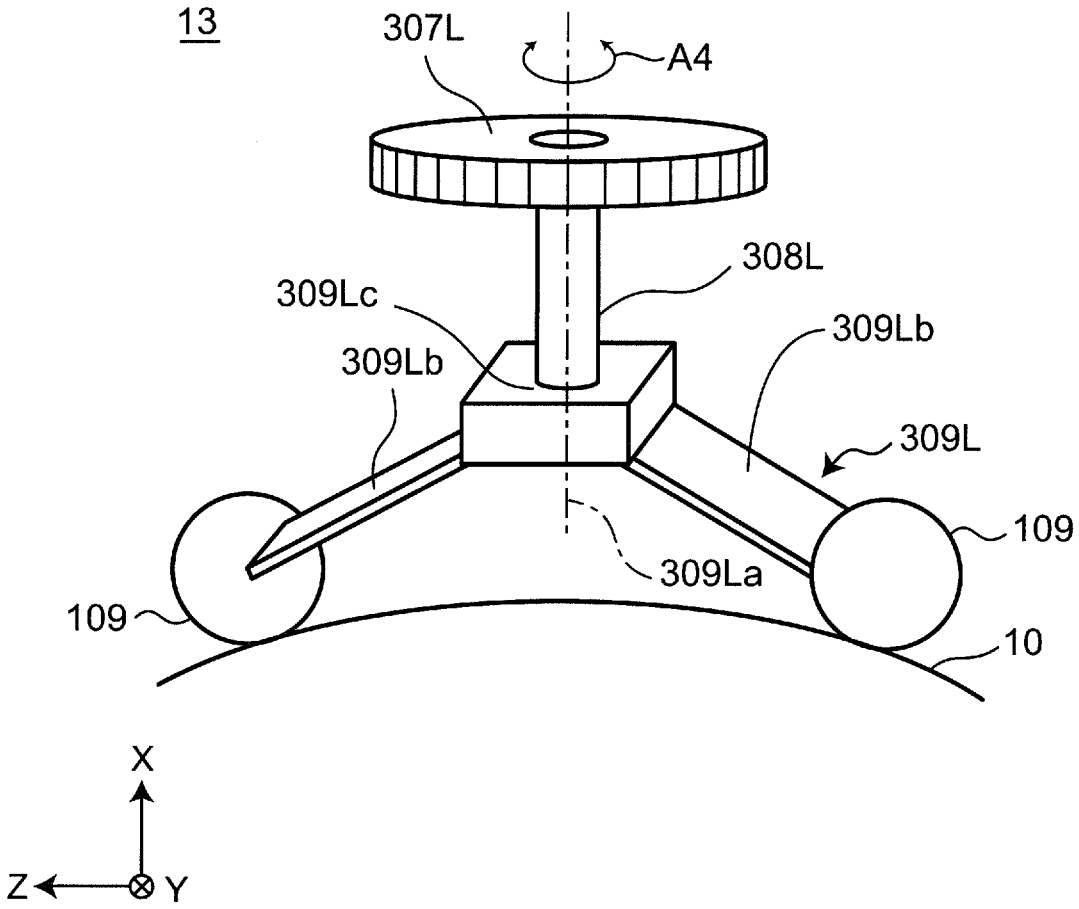
Fig.4



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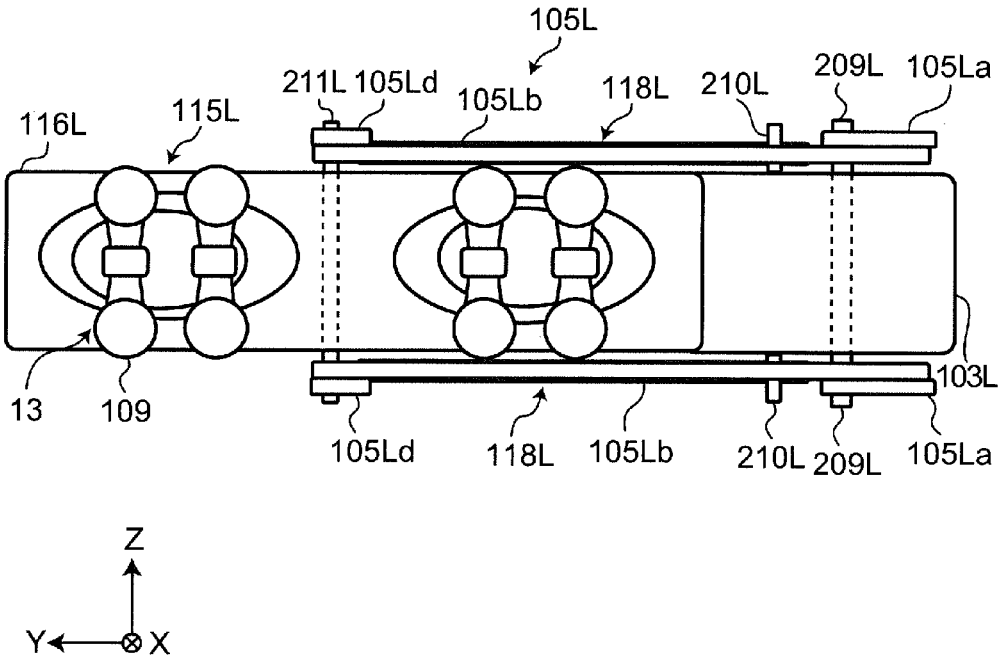
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Fig.6

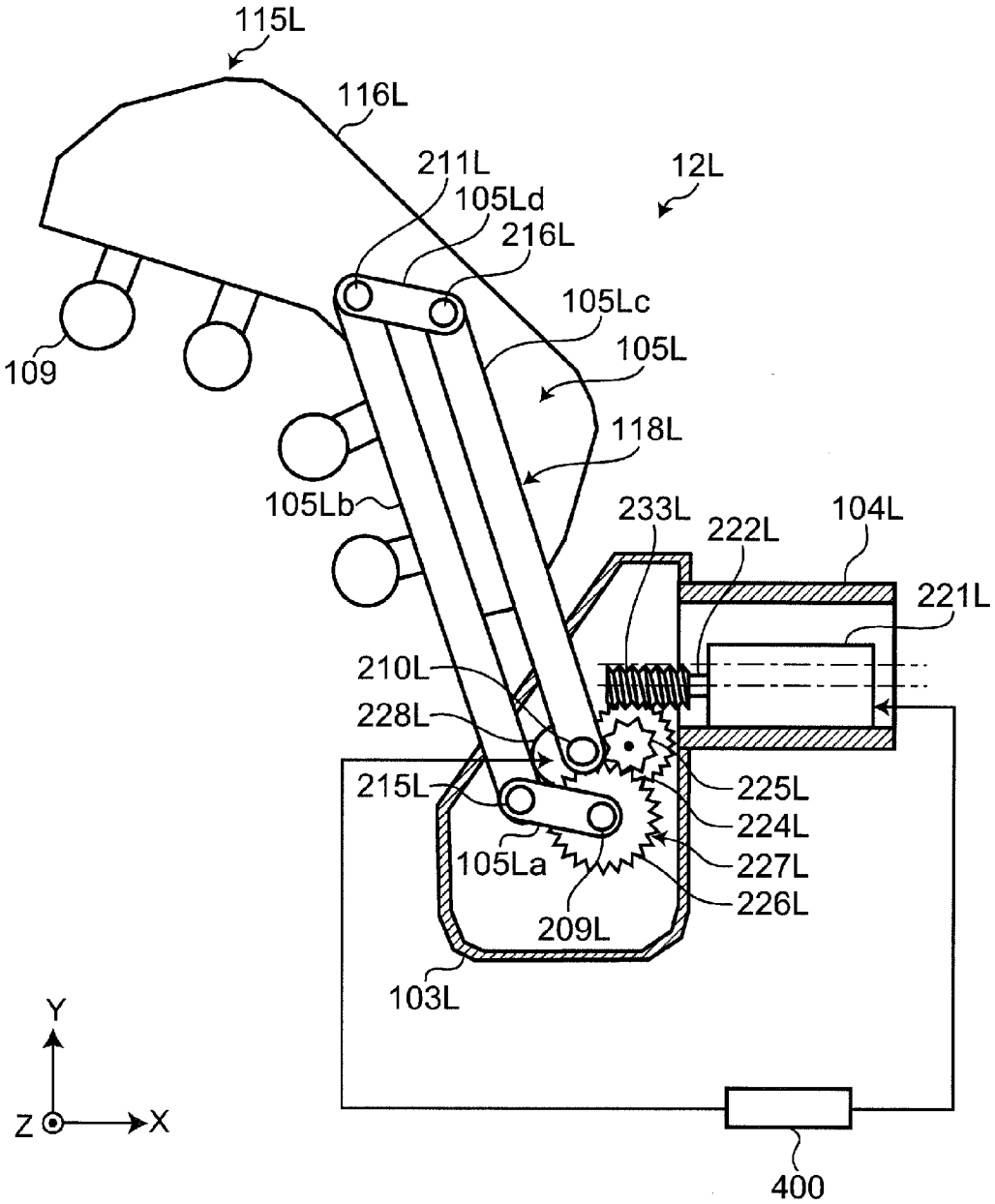
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Fig.7

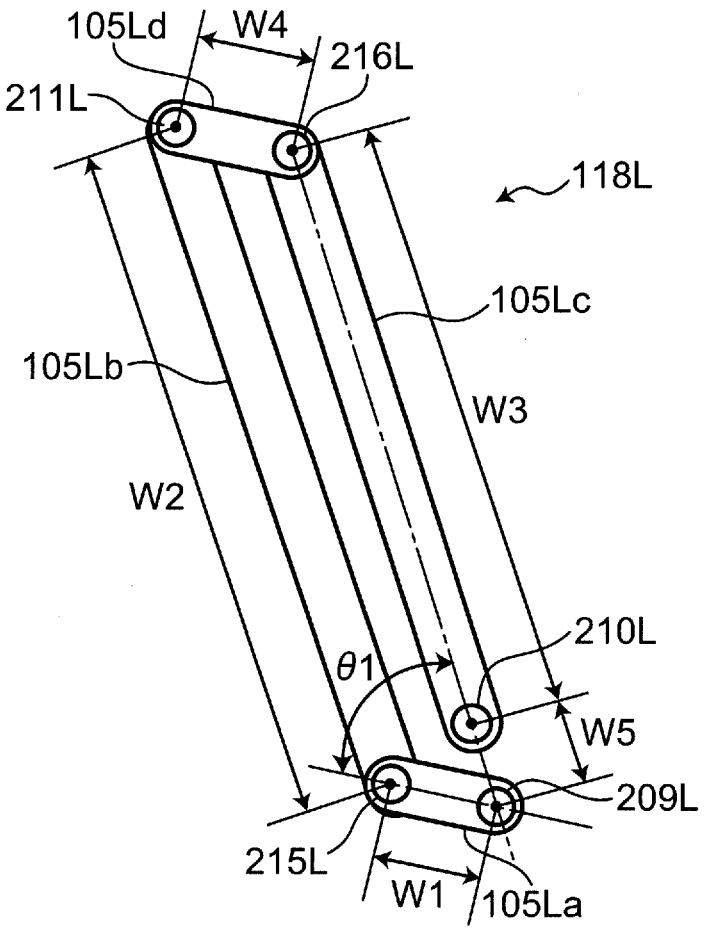
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Fig.8

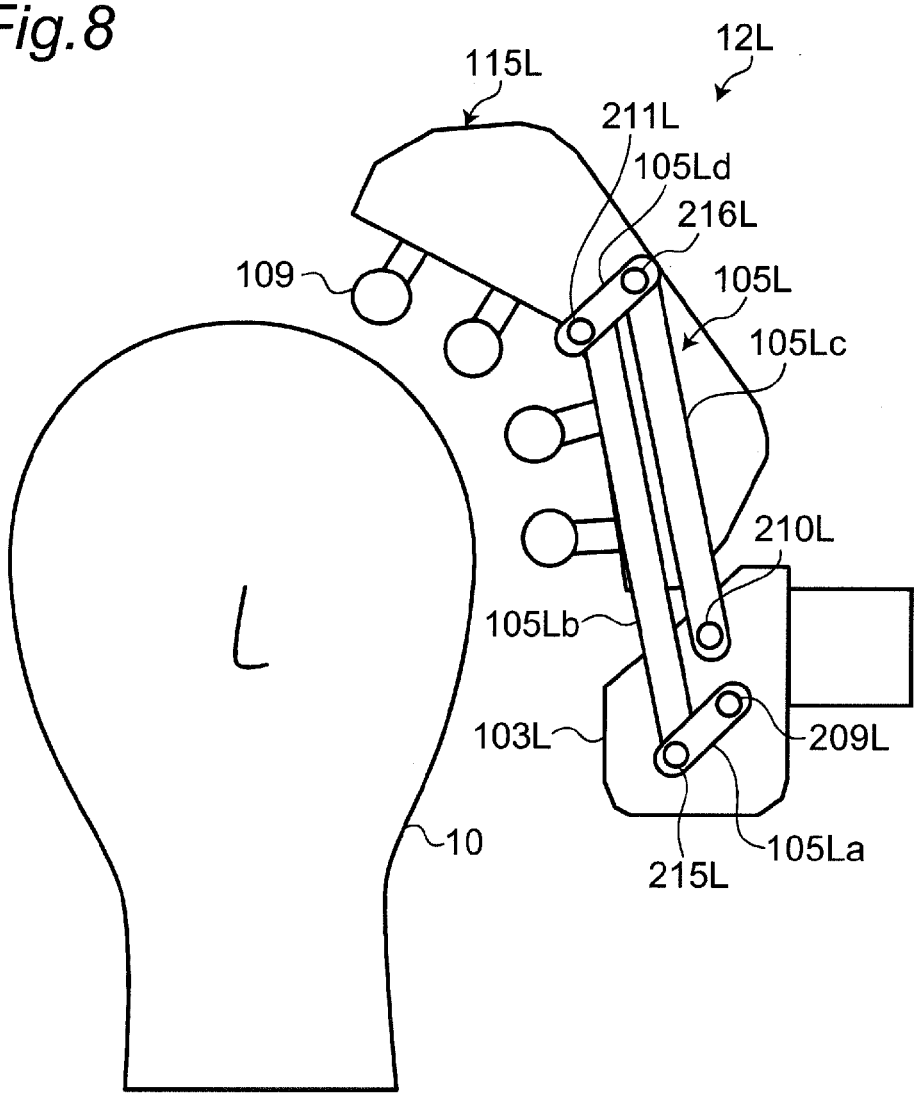
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Fig.9

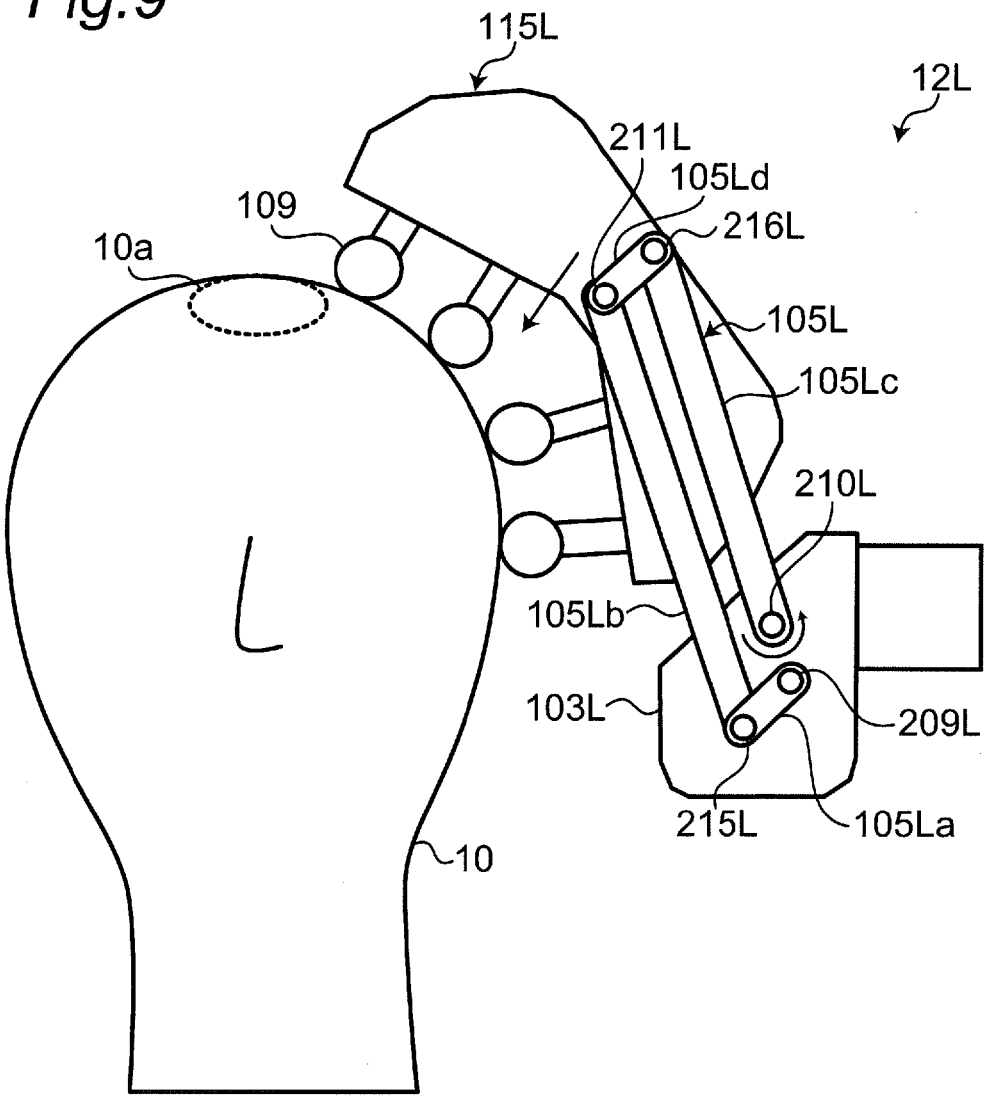
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Fig.10

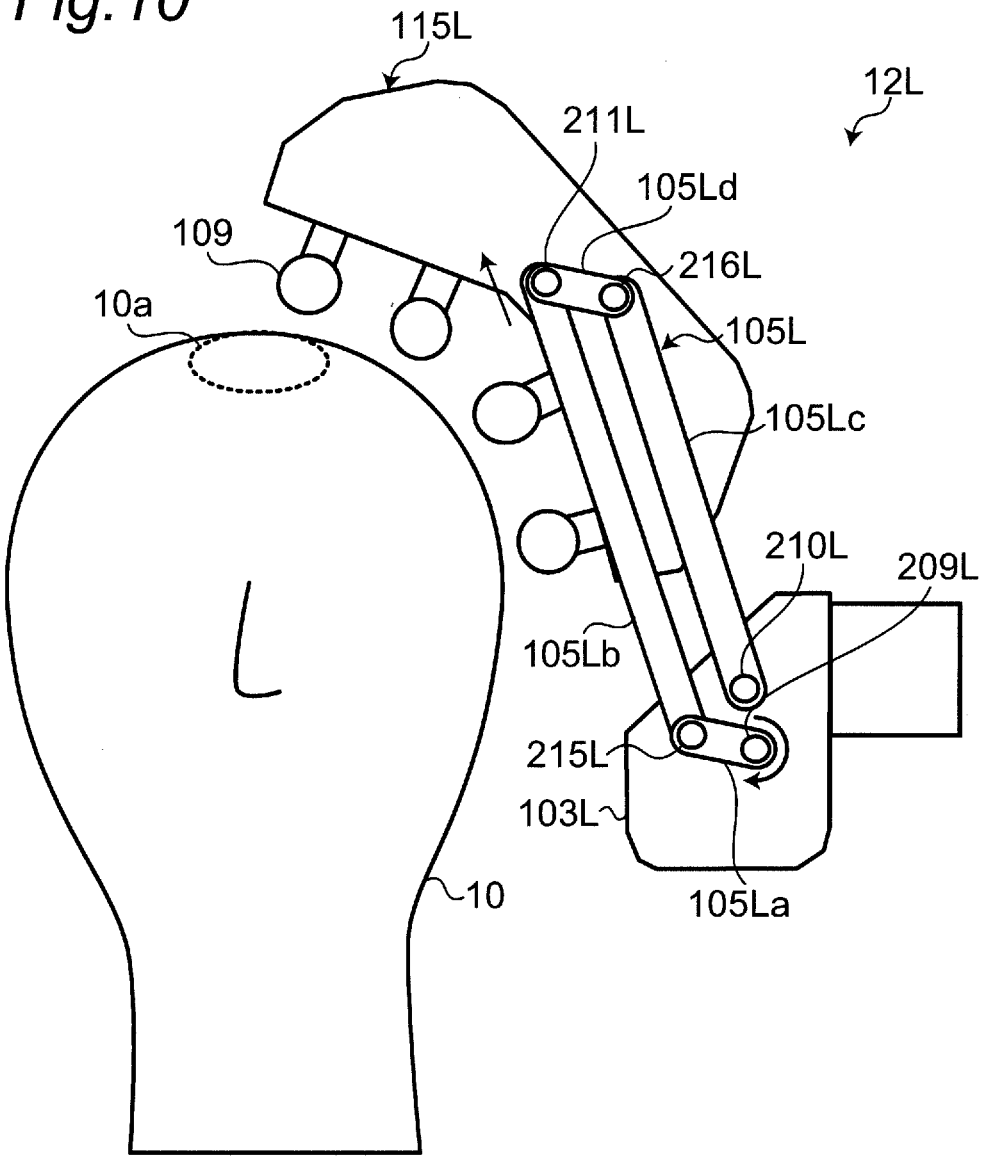
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Fig.11

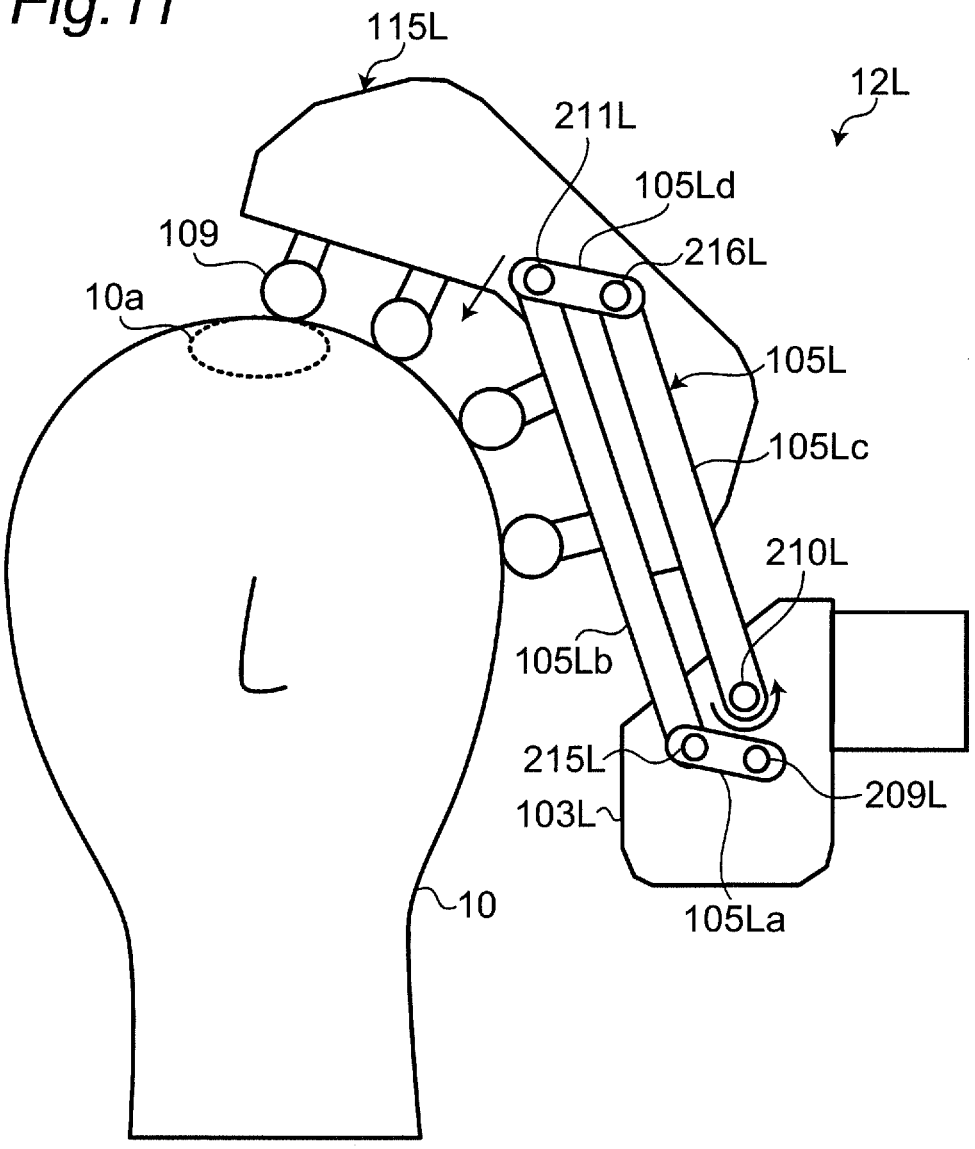
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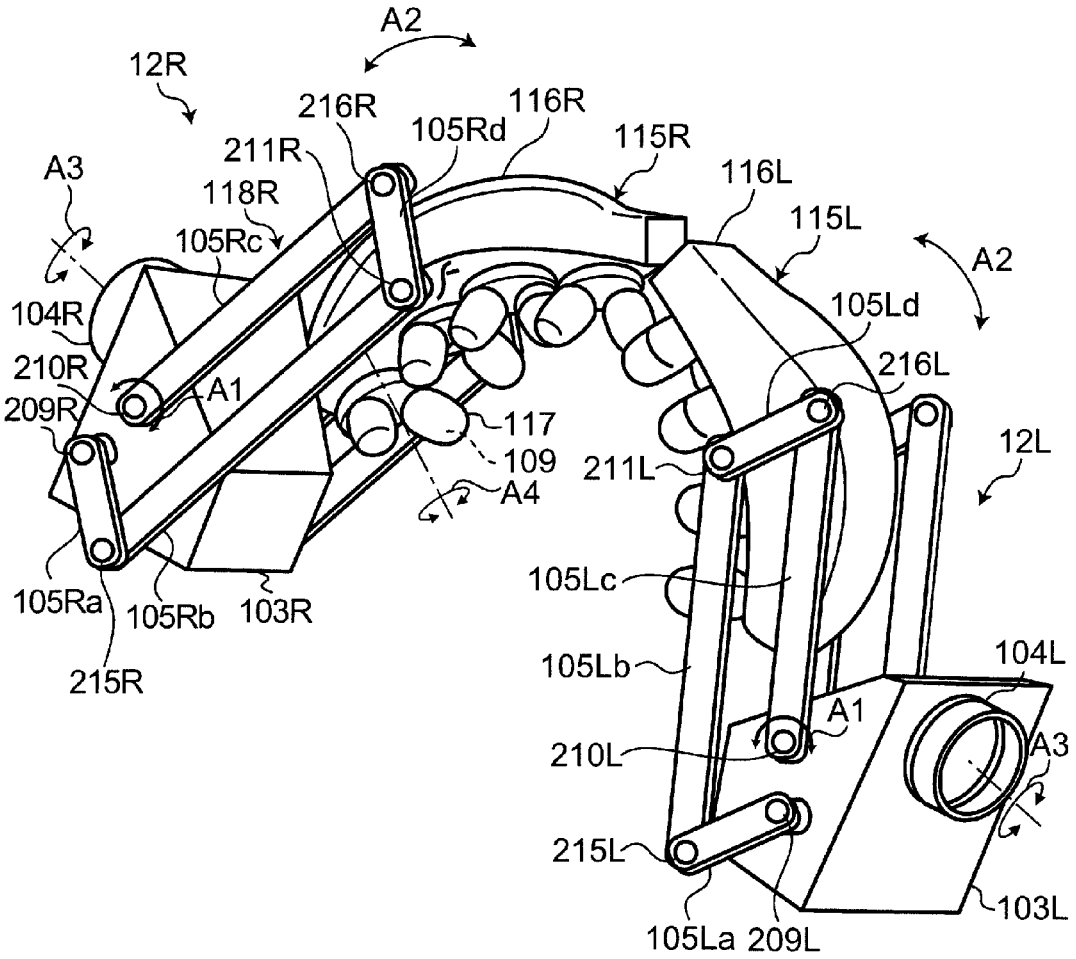
Fig.12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12L
109
211L
A4
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Fig.13

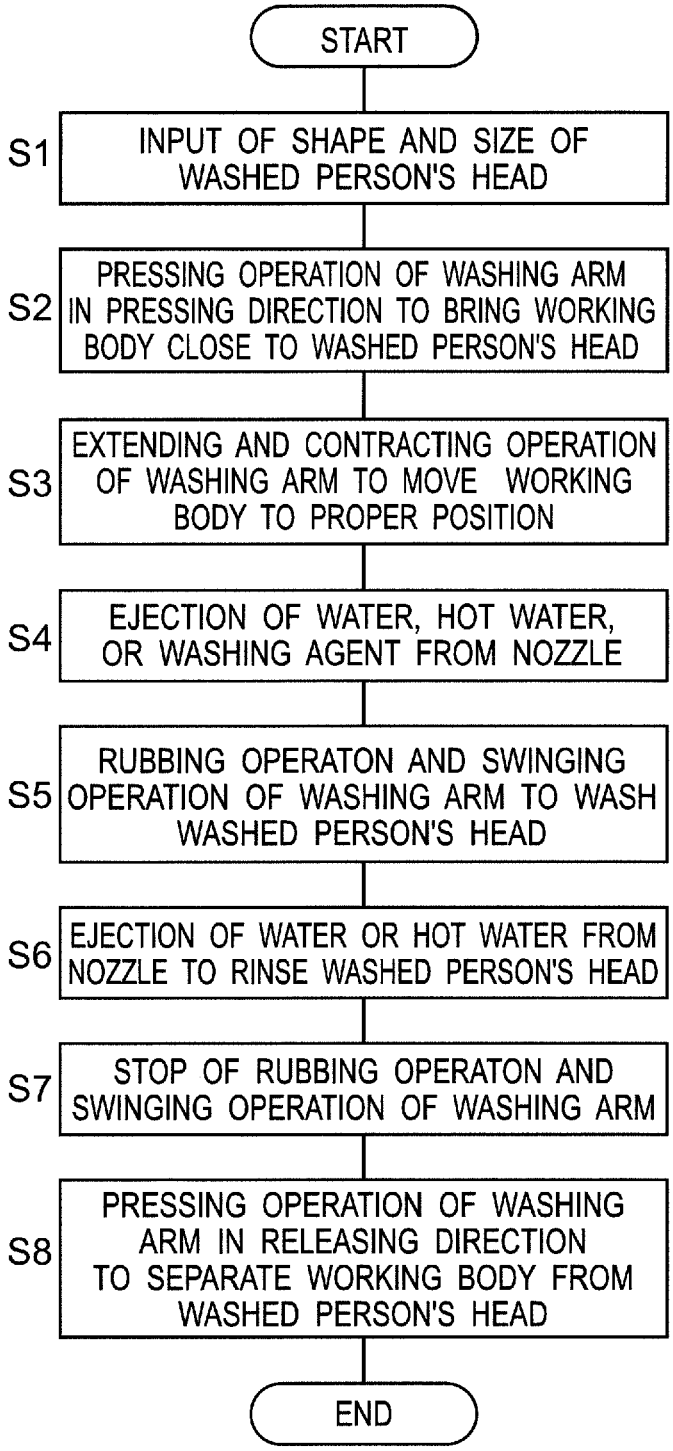

START
S1
INPUT OF SHAPE AND SIZE OF WASHED PERSON'S HEAD
S2
PRESSING OPERATION OF WASHING ARM IN PRESSING DIRECTION TO BRING WORKING BODY CLOSE TO WASHED PERSON'S HEAD
S3
EXTENDING AND CONTRACTING OPERATION OF WASHING ARM TO MOVE WORKING BODY TO PROPER POSITION
S4
EJECTION OF WATER, HOT WATER, OR WASHING AGENT FROM NOZZLE
S5
RUBBING OPERATON AND SWINGING OPERATION OF WASHING ARM TO WASH WASHED PERSON'S HEAD
S6
EJECTION OF WATER OR HOT WATER FROM NOZZLE TO RINSE WASHED PERSON'S HEAD
S7
STOP OF RUBBING OPERATON AND SWINGING OPERATION OF WASHING ARM
S8
PRESSING OPERATION OF WASHING ARM IN RELEASING DIRECTION TO SEPARATE WORKING BODY FROM WASHED PERSON'S HEAD
END

Fig.14A

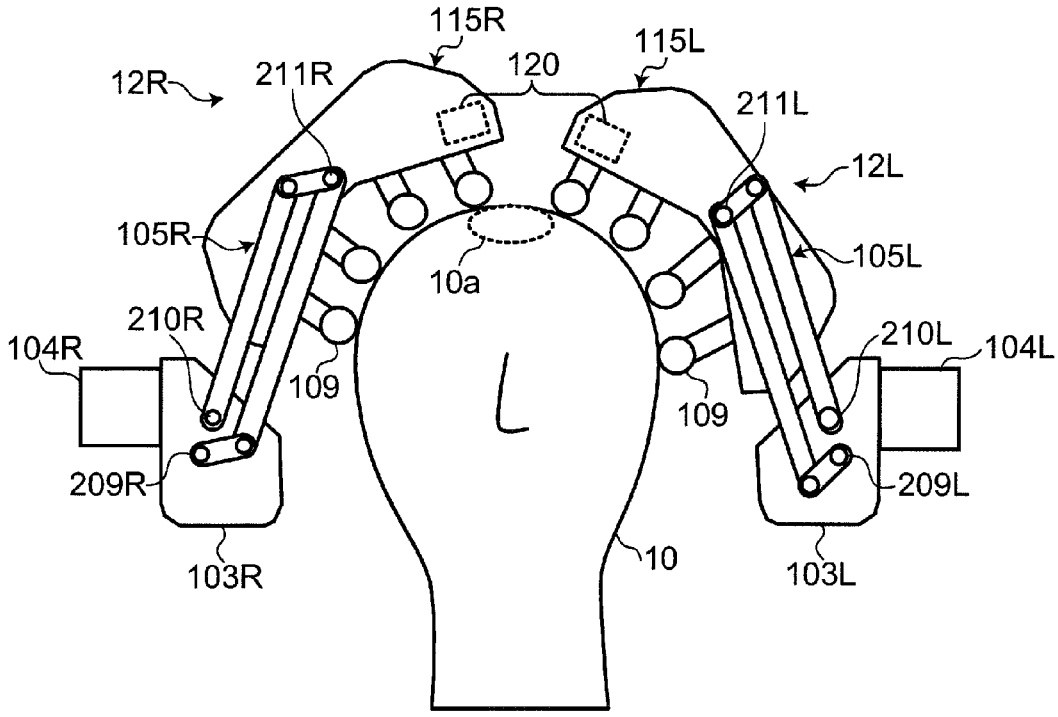
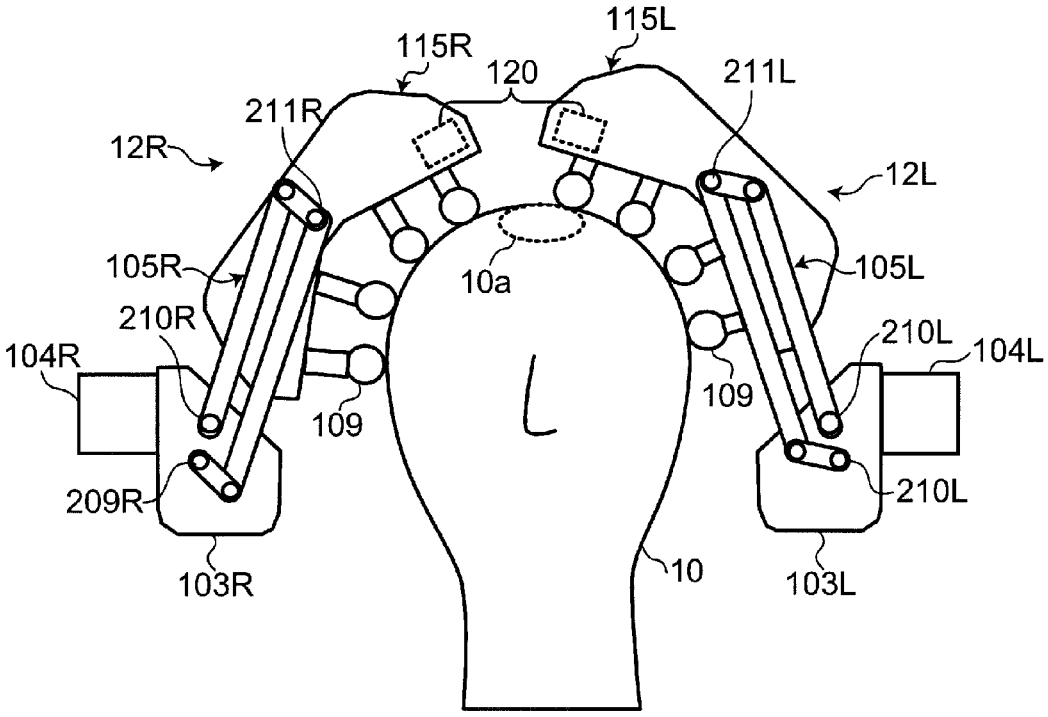


Fig.14B



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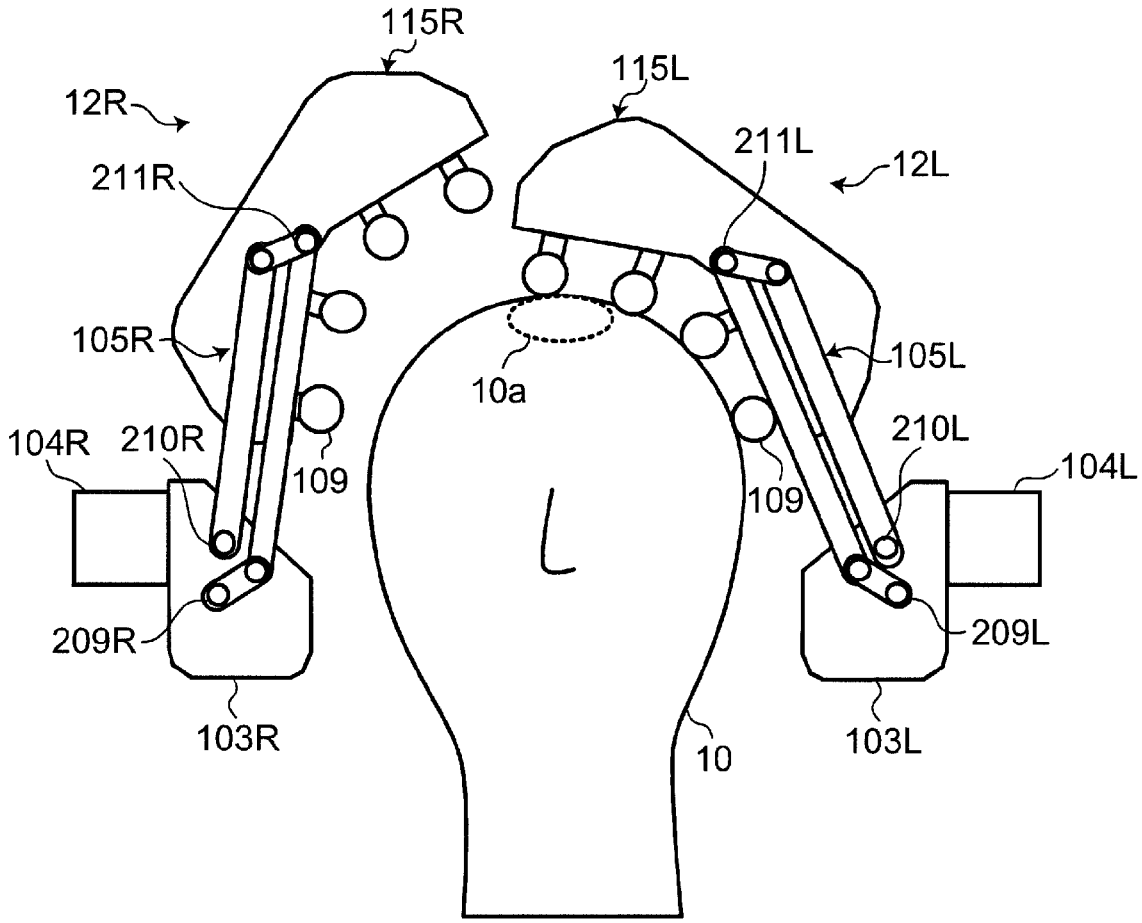
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Fig.16

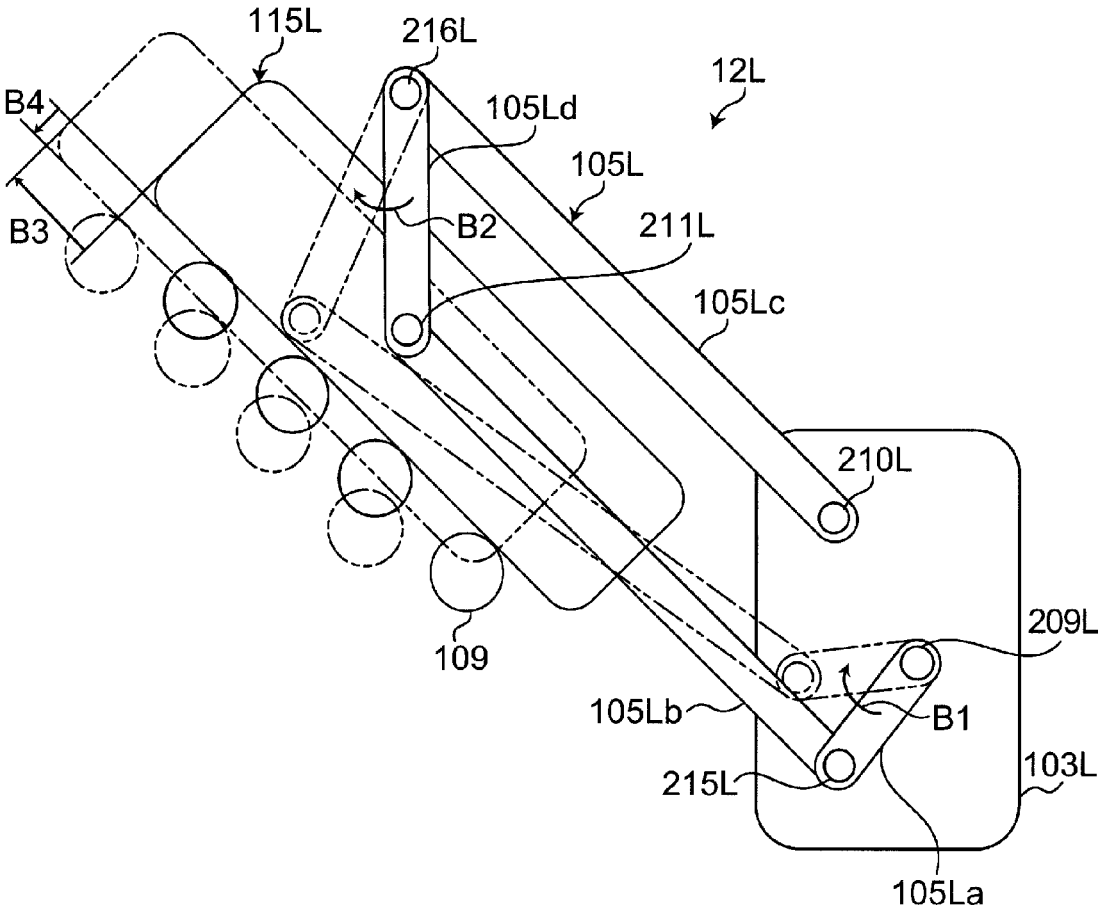
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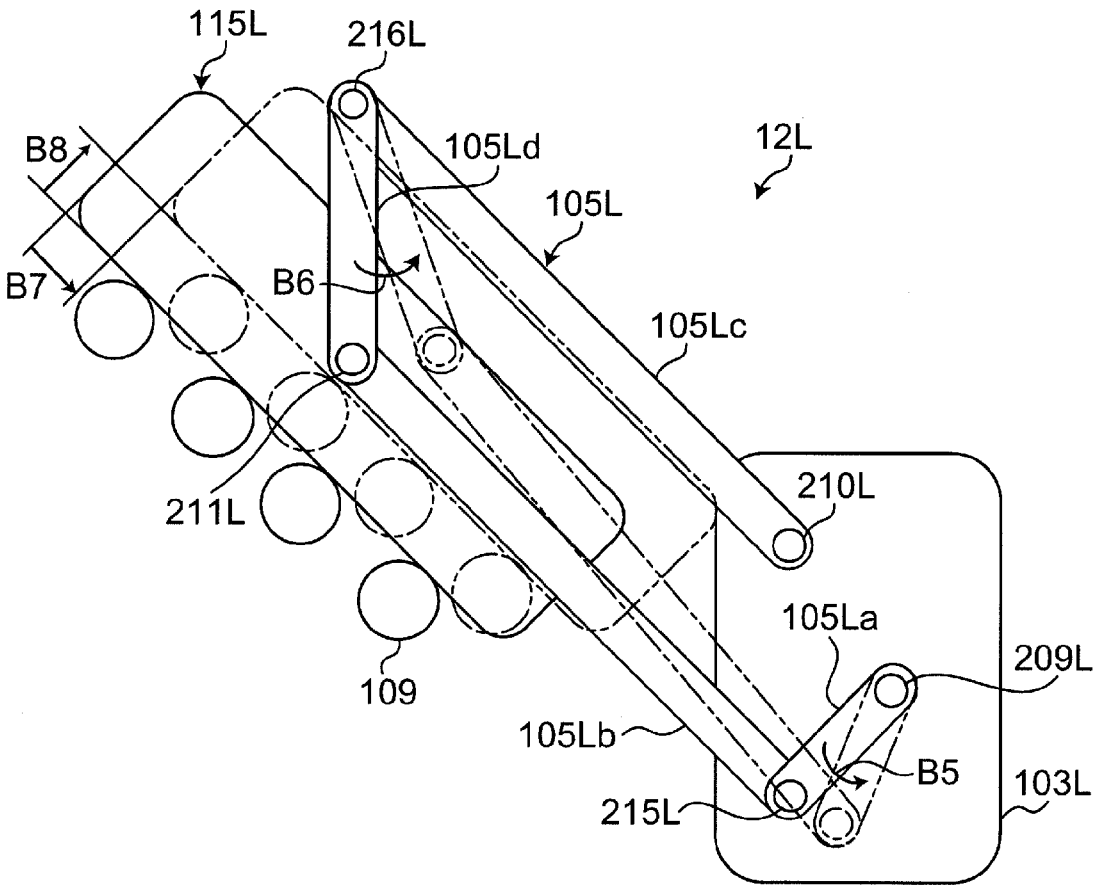
Fig.17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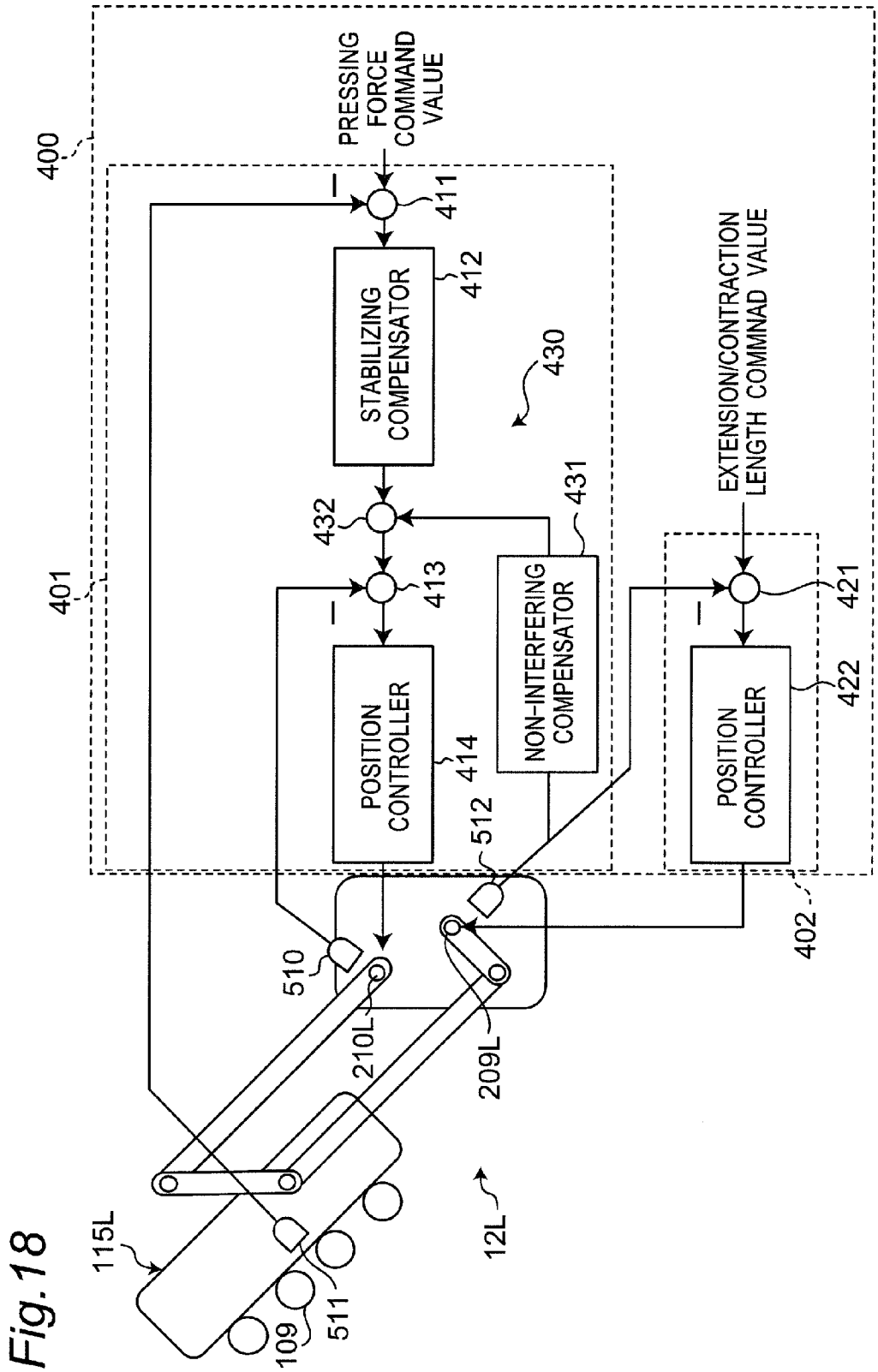
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Fig.18

Fig.19

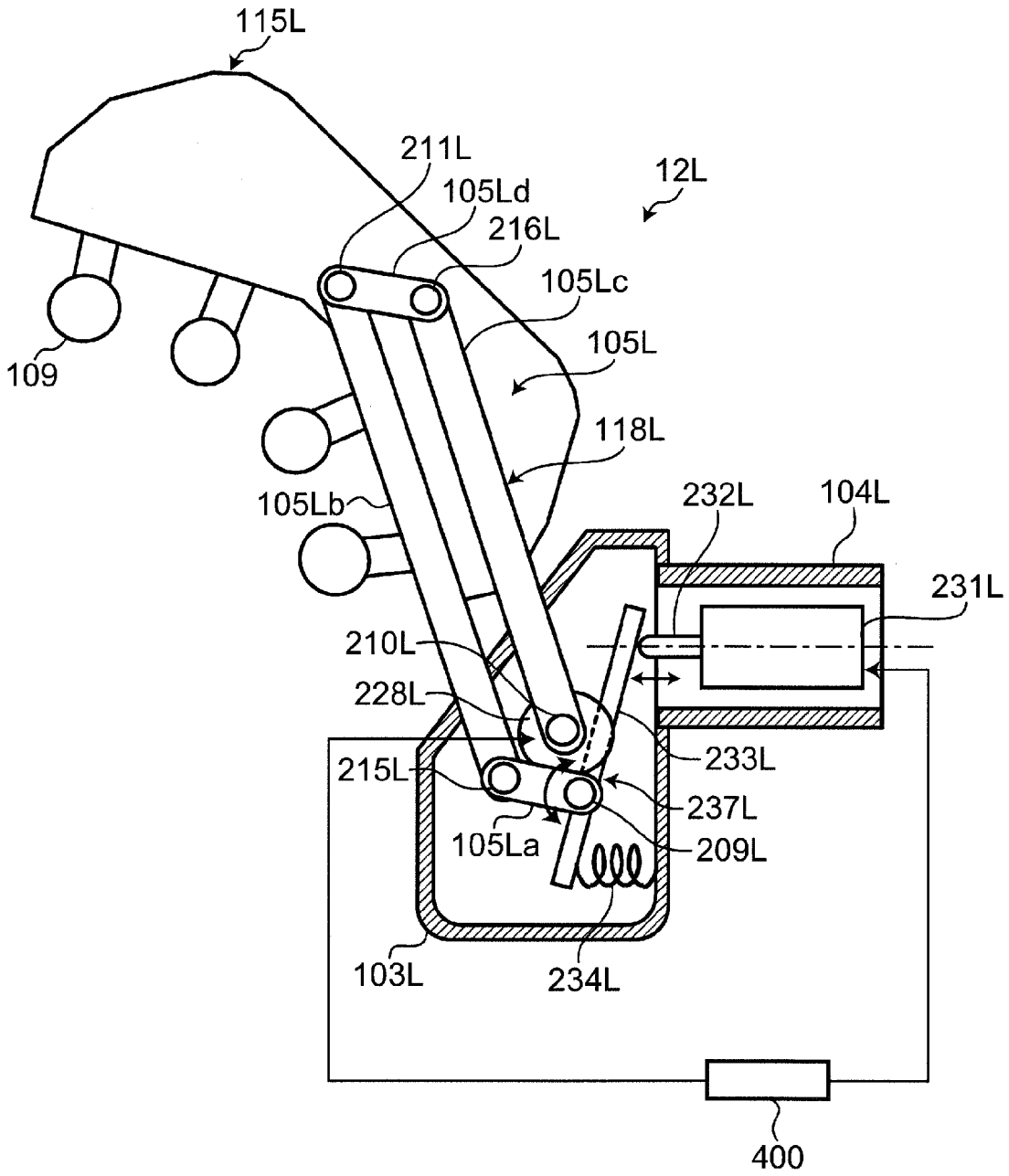
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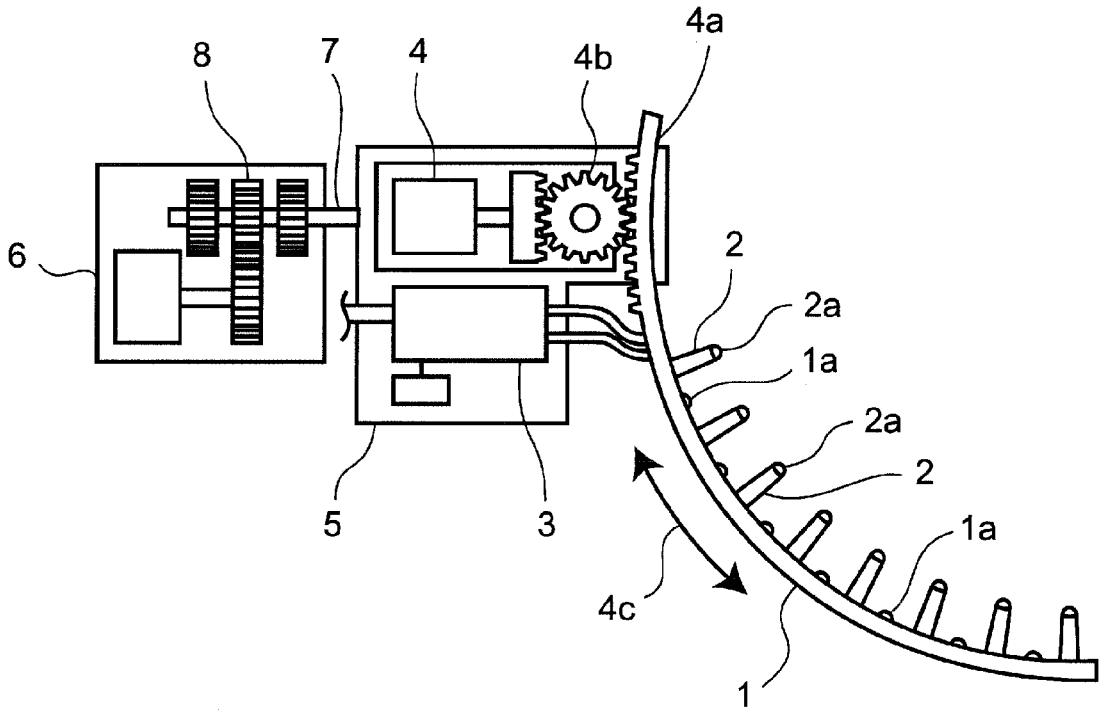
Fig.20 PRIOR ART



AUTOMATIC HEAD CARE DEVICE AND AUTOMATIC HEAD CARE METHOD

TECHNICAL FIELD

The present invention relates to an automatic head care device and an automatic head care method automatically caring a person's head in a medical field or beauty care industry.

BACKGROUND OF THE INVENTION

An example of person's head care is washing of a person's head. In the industry of beauty care including hair styling and hair cutting, head washing including hair is laborious and has been desired to be automated. Also in the medical field, head washing for inpatients is laborious and has been desired to be automated.

There has been known a device disclosed in Patent Document 1, for example, for washing person's hair automatically.

FIG. **20** is a view showing a schematic configuration of a main section of a conventional automatic head washing device. As shown in FIG. **20**, comb-like projections **2** are provided at regular intervals of the inner circumference of an arcuate washing unit **1** of the conventional automatic head washing device. A scalp washing nozzle **2***a* is provided at a tip of each of the comb-like projections **2**, and a hair washing nozzle **1***a* is provided between the comb-like projections **2**. These nozzles **1***a* and **2***a* are connected to an ejected liquid switching unit **3** via a liquid feeding path provided in the washing unit **1**. The automatic head washing device ejects cleaning agent or washing agent to scalp and hair from the nozzles **1***a* and **2***a* to wash a person's head.

The washing unit **1** is driven by a washing-unit reciprocation driving section **4** via a rack **4***a* and a pinion **4***b* to be movable in the directions of an arrow **4***c*. With this configuration, the washing unit **1** extends a washing area of scalp and hair. The washing unit **1**, the ejected liquid switching unit **3**, and the washing-unit reciprocation driving section **4** are supported by a washing-unit supporting section **5**. The washing-unit supporting section **5** is driven by a washing-unit rotational driving section **6** via a gear **8**, and is rotatable about a spindle **7**.

In the automatic head washing device, the ejected liquid switching unit **3**, the washing-unit reciprocation driving section **4**, and the washing-unit rotational driving section **6** are controlled in cooperation to perform the head washing operation. The use of the automatic head washing device enables washing of scalp and hair all over a person's head automatically, eliminating manual work.

Patent Document 1: JP 2001-149133 A

However, the above-mentioned conventional automatic head washing device washes the entire person's head by use of the nozzles fixed to one washing unit. For this reason, when the washing unit does not correspond to a person's head in shape or size, the washing unit nonuniformly contacts the person's head, resulting in that scalp and hair of the person's head cannot be completely washed, failing to acquire a satisfactory washing effect.

An object of the present invention is to provide an automatic head care device and an automatic head care method that can reliably care a person's head according to the shape or size of the person's head even when the washed person changes and accordingly, the person's head changes in shape or size.

SUMMARY OF THE INVENTION

To attain the object, an automatic head care device of the present invention includes: a base having a head support supporting a person's head; independently rotated first rotational driving shaft and second rotational driving shaft, a first link having one end fixed to the first rotational driving shaft; a second link having one end rotatably connected to another end of the first link; a third link having one end fixed to the second rotational driving shaft; a fourth link having one end rotatably connected to another end of the third link; a working shaft rotatably connecting another end of the second link to another end of the fourth link; a working body caring the person's head supported by the head support, the working body being rotatably supported by the working shaft; and a control unit controlling rotation of the first rotational driving shaft and the second rotational driving shaft.

To attain the object, an automatic head care method of the present invention is an automatic head care method using an automatic head care device including: a base having a head support supporting a person's head; independently rotated first rotational driving shaft and second rotational driving shaft; a first link having one end fixed to the first rotational driving shaft; a second link having one end rotatably connected to another end of the first link; a third link having one end fixed to the second rotational driving shaft; a fourth link having one end rotatably connected to another end of the third link; a working shaft rotatably connecting another end of the second link to another end of the fourth link; a working body rotatably supported by the working shaft; an arm base rotatably holding the first rotational driving shaft and the second rotational driving shaft; and a support shaft fixed to the arm base, the support shaft being rotatably attached to the base, the method comprising controlling rotation of the first rotational driving shaft and the second rotational driving shaft to cause the working body to make contact with the person's head supported by the head support, thereby caring the person's head.

Advantage of the Invention

An automatic head care device and an automatic head care method of the present invention can reliably care a person's head according to the shape or size of the person's head even when the person's head changes in shape or size.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of an automatic head washing device in accordance with a first embodiment of the present invention.

FIG. **2** is a view showing a configuration of a first main section of a drive mechanism of the automatic head washing device in accordance with the first embodiment.

FIG. **3** is a perspective view showing a second main section of the drive mechanism of the automatic head washing device in accordance with the first embodiment.

FIG. **4** is a perspective view showing a third main section of the drive mechanism of the automatic head washing device in accordance with the first embodiment.

FIG. **5** is a view showing a washing arm of the automatic head washing device in accordance with the first embodiment when viewed from a washed person.

FIG. **6** is a side partial cutout view showing the washing arm of the automatic head washing device in accordance with the first embodiment.

FIG. **7** is a view showing a first arm of the washing arm of the automatic head washing device in accordance with the first embodiment.

FIG. **8** is a view showing the washing arm of the automatic head washing device in accordance with the first embodiment in an initial state.

FIG. **9** is a view showing the washing arm of the automatic head washing device in accordance with the first embodiment in a pressing state.

FIG. **10** is a view showing an extending operation of the washing arm of the automatic head washing device in accordance with the first embodiment.

FIG. **11** is a view showing the extending operation of the washing arm of the automatic head washing device in accordance with the first embodiment.

FIG. **12** is a view showing the operation of the washing arms of the automatic head washing device in accordance with the first embodiment.

FIG. **13** is a flow chart showing a washing method of the automatic head washing device in accordance with the first embodiment.

FIG. **14**A is a view showing the operation of washing arms of an automatic head washing device in accordance with a second embodiment of the present invention.

FIG. **14**B is a view showing the operation of the washing arms of the automatic head washing device in accordance with the second embodiment.

FIG. **15** is a view showing the operation of washing arms of an automatic head washing device in accordance with a third embodiment of the present invention.

FIG. **16** is a view showing a change in the position of a working body with the rotation of a first link in the extending direction of the washing arm.

FIG. **17** is a view showing a change in the position of the working body with the rotation of the first link in the contracting direction of the washing arm.

FIG. **18** is a block diagram showing configurations of a pressing force control unit and an extension/contraction length control unit of the automatic head washing device in accordance with a fourth embodiment of the present invention.

FIG. **19** is a side partial cutout view showing a washing arm of an automatic head washing device in accordance with a fifth embodiment of the present invention.

FIG. **20** is a view showing a schematic configuration of a main section of a conventional automatic head washing device.

EMBODIMENTS OF THE INVENTION

Embodiments of the present invention will be described below with reference to the drawings. The same constituents are given the same reference symbols and description thereof may be omitted. To be easy to understand, the drawings schematically show each of the constituents. These drawings appropriately show a Z axis along the vertical direction, and X axis and Y axis perpendicular to the Z axis.

According to the present invention, an automatic head washing device automatically washing a person's head of a washed person will be described as an example of an automatic head care device automatically a caring person's head. The expression "caring a person's head" according to the present invention refers to at least one of washing of scalp of a person's head, washing hair of a person's head (hair washing), and massage of a person's head. In following description of the embodiments, "left", "right", "front" or "rear" refers to the direction when viewed from the person whose head is washed.

First Embodiment

FIG. **1** is a perspective view showing an automatic head washing device in accordance with a first embodiment of the present invention. FIG. **2** is a view showing a configuration of a first main section of a drive mechanism of the automatic head washing device in accordance with the first embodiment.

As shown in FIG. **1**, an automatic head washing device **100** in accordance with the first embodiment has a bowl **101**. The bowl **101** is an example of a base having a head support **11** supporting a head **10** of the washed person. The bowl **101** is configured to surround a substantially half of a rear part of the person's head **10**. Support columns **102**L and **102**R are mounted in a housing **101***a* constituting the bowl **101**. The support columns **102**L and **102**R are located on left and right sides of the head support **11**, respectively, across the head support **11** in the bowl **101**.

The automatic head washing device **100** has a pair of two washing arms **12** washing the person's head **10** supported in the bowl **101**. The pair of washing arms **12** are configured of a left washing arm **12**L and a right washing arm **12**R, which are disposed across the head support **11** in the bowl **101**. The bowl **101** is provided with a hood **113** preventing scattering of water during washing.

The washing arm **12**L has a working body **115**L washing the person's head **10**, a first arm **105**L rotatably supporting the working body **115**L, an arm base **103**L to which the first arm **105**L is attached, a support shaft **104**L fixed to the arm base **103**L, and a pipe **111**L fixed to the arm base **103**L. The working body **115**L is an example of a working body caring the person's head **10**. The pipe **111**L is an example of piping.

As shown in FIG. **2**, in the washing arm **12**L, the support shaft **104**L is rotatably coupled to the support column **102**L, and can rotate about the support shaft **104**L. That is, in the washing arm **12**L, the support shaft **104**L is rotatably attached to the bowl **101** via the support column **102**L, and can rotate about the support shaft **104**L.

A motor **201**L is disposed in the support column **102**L. A rotation output of the motor **201**L is transmitted to the support shaft **104**L via a gear **203**L attached to a motor rotation output shaft **202**L and a gear **204**L attached to the support shaft **104**L. The arm base **103**L fixed to the support shaft **104**L is driven by the rotation output transmitted from the motor **201**L to be rotatable about the support shaft **104**L. Driving of the motor **201**L is controlled by a control unit **400**.

The pipe **111**L of the washing arm **12**L has a plurality of nozzles **110** ejecting at least one of water, hot water, washing agent, or conditioner. The nozzles **110** are formed on an opposed surface of the pipe **111**L. The opposed surface of the pipe **111**L is a surface of the pipe **111**L, which faces the head support **11**. The pipe **111**L is attached to the arm base **103**L, and can rotate about the support shaft **104**L together with the arm base **103**L.

As shown in FIG. **2**, the automatic head washing device **100** includes a water system valve **216**, a washing agent system valve **217**, and a conditioner system valve **218**. Outlets of the water system valve **216**, the washing agent system valve **217**, and the conditioner system valve **218** are connected to one another in parallel, and are connected to the pipe **111**L and a pipe **111**R via piping **219**.

An inlet of the water system valve **216** is connected to a water system supplying unit to receive water or hot water from the water system supplying unit. An inlet of the washing agent system valve **217** is connected to a mixing unit **220***a* mixing washing agent and compressed air to receive mousse-like washing agent. The mousse-like washing agent supplied to the washing agent system valve **217** is produced by mixing washing agent and compressed air in the mixing unit **220***a*, the washing agent from a washing agent supplying unit **220***c* supplying washing agent such as shampoo. An inlet of the

conditioner system valve **218** is connected to a conditioner supplying unit **220***b* to receive conditioner (for example, rinse) from the conditioner supplying unit **220***b*.

The control unit **400** of the automatic head washing device **100** appropriately control the water system valve **216**, the washing agent system valve **217**, and the conditioner system valve **218** to cause the plurality of nozzles **110** provided on the pipes **111**L and **111**R to eject water, hot water, mousse-like washing agent, or conditioner.

The water supplying unit supplying water or hot water to the washing arms **12**L and **12**R is configured of the water system supplying unit and the water system valve **216**. The washing agent supplying unit supplying washing agent to the washing arms **12**L and **12**R is configured of the washing agent supplying unit **220***c*, the mixing unit **220***a*, and the washing agent system valve **217**. The conditioner supplying unit supplying conditioner to the washing arms **12**L and **12**R is configured of the conditioner supplying unit **220***b* and the conditioner system valve **218**.

The working body **115**L of the washing arm **12**L includes a second arm **106**L rotatably supported by the first arm **105**L through a support shaft **211**L, a third arm **107**L rotatably supported by the second arm **106**L through a support shaft **213**L, a third arm **108**L rotatably supported by the second arm **106**L through a support shaft **213**L, and a housing **116**L covering the second arm **106**L and the third arms **107**L and **108**L.

The second arm **106**L has a predetermined shape, such as, substantially arcuate shape and substantially linear shape. The second arm **106**L rotatably supports the third arm **107**L through the support shaft **213**L at one end, and rotatably supports the third arm **108**L through a support shaft **214**L at the other end. The two third arms **107**L and **108**L are supported by the second arm **106**L so as to be substantially symmetric about the support shaft **211**L.

An elastic body such as spring is provided between the second arm **106**L and the first arm **105**L to hold the second arm **106**L at a predetermined position with respect to the first arm **105**L. The elastic body restricts positional relationship between the second arm **106**L and the first arm **105**L, between the second arm **106**L and the first arm **105**L. For example, the elastic body is configured to couple the second arm **106**L to the support shaft **211**L of the first arm **105**L. In place of the elastic body, means automatically aligning the second arm **106**L with the first arm **105**L may be used.

Elastic bodies such as springs are provided between the third arm **107**L and the second arm **106**L, and between the third arm **108**L and the second arm **106**L to hold the third arms **107**L and **108**L at respective predetermined positions with respect to the second arm **106**L. The elastic bodies are between the third arm **107**L and the second arm **106**L and between the third arm **108**L and the second arm **106**L, and restrict positional relationship therebetween. For example, the elastic bodies are provided to couple the third arms **107**L and **108**L to the support shafts **213**L and **214**L of the second arm **106**L, respectively. In place of the elastic bodies, means automatically aligning the third arms **107**L and **108**L with the second arm **106**L may be used.

A plurality of contacts **109** that make contact with the person's head **10** supported by the head support **11** are attached to each of the third arms **107**L and **108**L. Specifically, contact units each having the plurality of contacts **109** at their front ends are rotatably supported by the third arms **107**L and **108**L, thereby swingably attaching the plurality of contacts **109** to each of the third arms **107**L and **108**L. The contacts **109** each are made of an elastic rubber material.

The working body **115** will be further described below with reference to FIG. **3** and FIG. **4**.

FIG. **3** is a perspective view showing a second main section of the drive mechanism of the automatic head washing device in accordance with the first embodiment. In FIG. **3**, the housing **116**L and the second arm **106**L of the working body **115**L are not shown.

As shown in FIG. **3**, the working body **115**L includes, in the housing **116**L, a motor **301**L, a drive shaft **304**L transmitting the output from the motor **301**L, two cylindrical racks **306**L, and four contact units **13**. The two cylindrical racks **306**L engage with respective gears **305**L disposed on both ends of the drive shaft **304**L. The four contact units **13** each have the two contacts **109** at their front ends, and a gear **307**L engaged with the cylindrical rack **306**L.

The cylindrical racks **306**L are substantially cylindrical as a whole, and each include an axisymmetric rack mechanism **306**La on a side surface thereof. The cylindrical racks **306**L are each configured such that the rack mechanism **306**La engages with the gear **305**L attached to the drive shaft **304**L as well as the gear **307**L of the contact unit **13**. The cylindrical racks **306**L are rotatably supported by the support shafts **213**L and **214**L to be movable parallel to the support shafts **213**L and **214**L.

FIG. **4** is a perspective view showing a third main section of the drive mechanism of the automatic head washing device in accordance with the first embodiment. FIG. **4** shows the contact unit **13**. In FIG. **4**, the gear **307**L of the contact unit **13** is circular. As shown in FIG. **4**, the contact unit **13** has a substantially V-like fourth arm **309**L having the two contacts **109** at its front ends, and a rotation shaft **308**L connected to the fourth arm **309**L as well as to the gear **307**L.

The fourth arm **309**L has a pair of branches **309**Lb and a connection **309**Lc, and the connection **309**Lc is connected to the rotation shaft **308**L. The pair of branches **309**Lb have the contacts **109** at their front ends, and are disposed symmetric about an axis of symmetry A4. The connection **309**Lc couples the two branches **309**Lb to each other at a top of the V-like branches **309**Lb.

The fourth arm **309**L is configured to include an elastic body in at least a part of an area ranging from the top of the V-like branches **309**Lb to the contacts **109**. In the fourth arm **309**L of the contact unit **13** in FIG. **4**, the branches **309**Lb each function as a plate spring as an example of the elastic body.

The central axis of the rotation shaft **308**L of the contact unit **13** corresponds to an axis of symmetry **309**La of the fourth arm **309**L. The contact unit **13** is supported by the third arm **107**L such that the rotation shaft **308**L can rotate. Thus, when the gear **307**L rotates, the gear **307**L and the contacts **109** integrally rotate about the rotation shaft **308**L as represented by an arrow A4, and the contacts **109** swing about the rotation shaft **308**L. The rotation shaft **308**L is configured so as to maintain engagement between the cylindrical rack **306**L and the gear **307**L, for example, by including flanges in top and bottom portions across the third arm **107**L.

As shown in FIG. **3**, the two contact units **13** are attached to the third arm **107**L. The two contact units **13** have the same configuration, and are disposed symmetric about the support shaft **213**L. Similarly, the two contact units **13** are attached to the third arm **108**L, and are disposed symmetric about the support shaft **214**L.

In the working body **115**L, the rotation output of the motor **301**L is transmitted to the drive shaft **304**L, and the cylindrical racks **306**L are moved in the direction parallel to the support shafts **213**L and **214**L by the rotation output trans-

mitted from the motor **301**L to the drive shaft **304**L, thereby causing each of the gears **307**L to rotate about the rotation shaft **308**L.

When the gear **307**L rotates about the rotation shaft **308**L, the two contacts **109** rotate integrally with the gear **307**L, and the contacts **109** swing. The contacts **109** swing in contact with the person's head **10** to wash the person's head **10**.

In the working body **115**L, the second arm **106**L and the third arms **107**L and **108**L are stored in the housing **116**L. The contacts **109** attached to the third arms **107**L and **108**L are disposed outside the housing **116**L. In the working body **115**L, the support shaft **211**L of the first arm **105**L that rotatably supports the second arm **106**L is rotatably attached to the housing **116**L.

FIG. **5** is a view showing the washing arm of the automatic head washing device in accordance with the first embodiment when viewed from the washed person. FIG. **6** is a side partial cutout view showing the washing arm of the automatic head washing device in accordance with the first embodiment. FIG. **6** shows the cutout arm base **103**L and support shaft **104**L of the washing arm **12**L. In FIG. **5** and FIG. **6**, the pipe **111**L of the washing arm **12**L is not shown.

As shown in FIG. **5** and FIG. **6**, the first arm **105**L of the washing arm **12**L includes a first arm rotation shaft **209**L as a first rotational driving shaft and a second arm rotation shaft **210**L as a second rotational driving shaft, which are independently rotated. The first arm rotation shaft **209**L and the second arm rotation shaft **210**L each are rotatably held by the arm base **103**L.

A rotational motor **221**L as a first actuator that rotates the first arm rotation shaft **209**L is disposed in the support shaft **104**L of the washing arm **12**L. The motor **221**L is disposed in the cylindrical support shaft **104**. An output shaft **222**L of the motor **221**L extends parallel to the support shaft **104**L.

Since the output shaft **222**L of the motor **221**L is disposed in the support shaft **104**L so as to extend parallel to the support shaft **104**L, it is no need to dispose the motor **221**L at the arm base **103**L, and as compared to the case where the motor **221**L is disposed at the arm base **103**L, the arm base **103**L can be made more compact. As a result, the bowl **101** can be reduced in size, miniaturizing the automatic head washing device **100**.

A first conversion mechanism **227**L is disposed in the arm base **103**L. The first conversion mechanism **227**L converts the motion of the output shaft **222**L of the motor **221**L into the rotation of the first arm rotation shaft **209**L. The first conversion mechanism **227**L has a worm **223**L and a worm wheel **224**L that convert the rotation of the output shaft **222**L of the motor **221**L into the rotation of the first arm rotation shaft **209**L. The worm **223**L is fixed to the output shaft **222**L of the motor **221**L.

The worm wheel **224**L is provided so as to engage with the worm **223**L. The first conversion mechanism **227**L has a gear **225**L coaxially fixed to the worm wheel **224**L and a gear **226**L that engages with the gear **225**L and is coaxially fixed to the first arm rotation shaft **209**L.

The first conversion mechanism **227**L converts the rotation of the output shaft **222**L of the motor **221** into the rotation of a first arm rotation shaft **229**L via the worm **223**L, the worm wheel **224**L, the gear **225**L, and the gear **226**L. Driving of the motor **221**L is controlled by the control unit **400**.

The first conversion mechanism **227**L is configured of the worm **223**L and the worm wheel **224**L. Accordingly, the first conversion mechanism **227**L can convert the rotation of the output shaft **222**L of the motor **221** into the rotation of the first arm rotation shaft **229**L, but cannot convert the rotation of the first arm rotation shaft **229**L into the rotation of the output shaft of the motor **221**L. That is, the first conversion mechanism **227**L has an irreversible function.

A motor **228**L as a second actuator rotating the second arm rotation shaft **210**L is disposed in the arm base **103**L. A second conversion mechanism converting the rotation of the output shaft of the motor **228**L into the rotation of the second arm rotation shaft **210**L is disposed in the arm base **103**L.

The second conversion mechanism has a first spur gear fixed to an output shaft of the motor **228**L and a second spur gear that engages with the first spur gear and is coaxially fixed to the second arm rotation shaft **210**L, and reversibly converts the rotation of the output shaft of the motor **228**L into the rotation of the second arm rotation shaft. That is, the second conversion mechanism has a reversible function. Driving of the motor **228**L is controlled by the control unit **400**.

The first arm **105**L includes two five-joint link mechanisms **118**L and the support shaft **211**L. The two five-joint link mechanisms **118**L have the same shape, and as shown in FIG. **5**, are disposed parallel to each other across the working body **115**L. The support shaft **211**L couples the two five-joint link mechanisms **118**L to each other, and rotatably supports the working body **115**L. The support shaft **211**L is an example of a working shaft rotatably supporting the working body **115**L.

The five-joint link mechanisms **118**L each include a first link **105**La having one end fixed to the first arm rotation shaft **209**L, a second link **105**Lb having one end rotatably connected to the other end of the first link **105**La through a support shaft **215**L, a third link **105**Lc having one end fixed to the second arm rotation shaft **210**L, and a fourth link **105**Ld having one end rotatably connected to the other end of the third link **105**Lc through a support shaft **216**L. The other end of the second link **105**Lb is rotatably connected to the other end of the fourth link **105**Ld through the support shaft **211**L.

FIG. **7** is a view showing the first arm of the washing arm of the automatic head washing device in accordance with the first embodiment. FIG. **7** shows the five-joint link mechanism **118**L of the first arm **105**L. As shown in FIG. **7**, the five-joint link mechanism **118**L is configured of four linear links: the first link **105**La, the second link **105**Lb, the third link **105**Lc, and the fourth link **105**Ld.

In the five-joint link mechanism **118**L, it is assumed that the link length of the first link **105**La is W1, the link length of the second link **105**Lb is W2, the link length of the third link **105**Lc is W3, the link length of the fourth link **105**Ld is W4, and the distance between the center of the first arm rotation shaft **209**L and the center of the second arm rotation shaft **210**L is W5. In the five-joint link mechanisms **118**L in the first embodiment, the ratio of the link length W1 of the first link **105**La to the link length W4 of the second link **105**Ld is set to "W1:W4=1:1". The link length W1 of the first link **105**La is the distance between the center of the first arm rotation shaft **209**L and the center of the support shaft **215**L, and the link length W4 of the fourth link **105**Ld is the distance between the center of the support shaft **216**L and the center of the support shaft **211**L.

In the five-joint link mechanisms **118**L in the first embodiment, the link length W3 of the third link **105**Lc is set to be larger than the link length W1 of the first link **105**La, and the link length W2 of the second link **105**Lb is set to be larger than the link length W3 of the third link **105**Lc. The link length W3 of the third link **105**Lc is the distance between the center of the second arm rotation shaft **210**L and the center of the support shaft **216**L, and the link length W2 of the second link **105**Lb is the distance between the center of the support shaft **215**L and the center of the support shaft **211**L.

In the five-joint link mechanisms **118**L in the first embodiment, the ratio among the link length W1 of the first link

105La, the link length W2 of the second link 105Lb, the link length W3 of the third link 105Lc, and the link length W4 of the fourth link 105Ld is set to "W1:W2:W3:W4=1:4:3.5:1". A sum of the distance W5 and the link length W3 of the third link 105Lc (W5+W3) is equal to the link length W2 of the second link 105Lb.

In the five-joint link mechanisms 118L, the second link 105Lb and the third link 105Lc are disposed such that the third link 105Lc is farther from the head support 11 than the second link 105Lb. As shown in FIG. 7, when the third link 105Lc is disposed on a line connecting the first arm rotation shaft 209L to the second arm rotation shaft 210L, the five-joint link mechanism 118L is parallelogrammical.

In the first arm 105L having the five-joint link mechanisms 118L thus configured, the first arm rotation shaft 209L rotates to rotate the first links 105La, and the second arm rotation shaft 210L rotates to rotate the second links 105Lb. In the left washing arm 12L, the first links 105La and the second links 105Lb of the first arm 105L rotate, thereby moving the support shaft 211L with respect to the arm base 103L and moving the working body 115L with respect to the arm base 103L. The rotation of the first arm rotation shaft 209L and the second arm rotation shaft 210L is controlled by the control unit 400.

FIG. 8 is a view showing the washing arm of the automatic head washing device in accordance with the first embodiment in an initial state. As shown in FIG. 8, in washing the person's head 10, the washing arm 12L is first placed in the predetermined initial state where the person's head 10 supported by the head support 11 does not interfere with the working body 115L. In the washing arm 12L in the initial state, the control unit 400 controls the rotation of the first arm rotation shaft 209L and the second arm rotation shaft 210L to control the position of the working body 115L.

FIG. 9 is a view showing the washing arm of the automatic head washing device in accordance with the first embodiment in a pressing state. When the person's head 10 supported by the head support 11 is washed, as shown in FIG. 9, the washing arm 12L is placed in the pressing state where the working body 115L (specifically, the contacts 109) presses the person's head 10 with a predetermined pressing force. In the state where the first arm rotation shaft 209L is fixed, by rotating the second arm rotation shaft 210L counterclockwise in FIG. 9 to move the working body 115 toward the head support 11, the working body 115L of the washing arm 12L presses the person's head 10.

When the second arm rotation shaft 210L is rotated in the state where the first arm rotation shaft 209L is fixed, the first links 105La do not move, and the second links 105Lb rotate about the support shaft 215L as a connection with the first links 105La counterclockwise in FIG. 9. As a result, a force toward the head support 11 is applied to the support shaft 211L as a connection with the fourth links 105Ld. Thereby, the working body 115L supported by the support shaft 211L moves toward the head support 11 to press the person's head 10.

As described above, in the washing arm 12L, when the second arm rotation shaft 210L is rotated in the state where the first arm rotation shaft 209L is fixed, the second links 105Lb rotate about the support shaft 215L, and the support shaft 215L connected to the second links 105Lb moves toward the head support 11. As a result, the working body 115L contacts the person's head 10 supported by the head support 11.

Since the working body 115L is rotatably supported by the support shaft 211L, when the working body 115L is brought into contact with the person's head 10 (specifically, when the contacts 109 are brought into contact with the person's head 10), the working body 115L rotates about the support shaft 211L, causing the contacts 109 to contact the person's head 10.

The working body 115L is supported by the support shaft 211L on the side of the head support 11. Thus, a supporting point of the working body 115L is located near the person's head 10 supported by the head support 11, thereby effectively bringing the working body 115L into contact with the person's head 10.

Even when the washing arm 12L is shifted from the initial state to the pressing state as shown in FIG. 9, depending on the shape or size of the person's head 10, the working body 115L may not contact with a vertex 10*a* of the person's head 10. However, in the washing arm 12L in this embodiment, the working body 115L can extend and contract with respect to the arm base 103L so as to be in contact with the whole of the person's head 10.

The working body 115L is extended and contracted with respect to the arm base 103L on the basis of the position of the person's head 10, which is detected by a position detector such as a camera detecting the position of the person's head 10. The extending operation of the washing arm 12L is performed, for example, when the working body 115L does not reach the vertex 10*a* of the person's head 10.

FIG. 10 is a view showing the extending operation of the washing arm of the automatic head washing device in accordance with the first embodiment. In the case where the working body 115L does not contact the person's head 10 even when the washing arm 12L is shifted from the initial state to the pressing state, as shown in FIG. 10, the washing arm 12L is extended to separate the working body 115L from the arm base 103.

By rotating the first arm rotation shaft 209L clockwise in FIG. 10 in the state where the second arm rotation shaft 210L is fixed, the working body 115L moves toward the vertex 10*a* of the person's head 10.

When the first arm rotation shaft 209L is rotated in the state where the second arm rotation shaft 210L is fixed, the third links 105Lc do not move, and the fourth links 105Ld rotate about the support shaft 216L as a connection with the third links 105Lc counterclockwise in FIG. 10. As a result, a force toward the vertex 10*a* of the person's head 10 is applied to the support shaft 211L as a connection with the second links 105Lb. Thereby, the working body 115L supported by the support shaft 211L moves toward the vertex 10*a* of the person's head 10.

As shown in FIG. 10, when the first arm rotation shaft 209L is rotated in the state where the second arm rotation shaft 210L is fixed and the working body 115L is moved toward the vertex 10*a* of the person's head 10, the working body 115L may be away from the person's head 10. For this reason, in the first embodiment, the working body 115 is moved toward the head support 11 to bring the working body 115 into contact with the person's head 10.

FIG. 11 is a view showing the extending operation of the washing arm of the automatic head washing device in accordance with the first embodiment. As shown in FIG. 10, the working body 115L of the washing arm 12L is moved toward the vertex. 10*a* of the person's head 10 and subsequently the second arm rotation shaft 210L is rotated counterclockwise in FIG. 11 in the state where the first arm rotation shaft 209L is fixed, and the working body 115 is moved toward the head support 11 to cause the working body 115L to press the person's head 10.

When the second arm rotation shaft 210L is rotated in the state where the first arm rotation shaft 209L is fixed, the first

links **105**La do not move, and the second links **105**Lb rotate about the support shaft **215**L counterclockwise in FIG. **11**. As a result, a force toward the head support **11** is applied to the support shaft **211**L. Thereby, the working body **115**L supported by the support shaft **211**L moves toward the head support **11** and presses the person's head **10** with a predetermined pressing force.

As described above, in the washing arm **12**L, by controlling the rotation of the first arm rotation shaft **209**L and the second arm rotation shaft **210**L, the working body **115**L can be extended with respect to the arm base **103**L.

When the working body **115**L is contracted with respect to the arm base **103**L in the washing arm **12**, as shown in FIG. **9**, the second arm rotation shaft **210**L is fixed in the state where the working body **115**L of the washing arm **12**L is in contact with the person's head **10** and subsequently the first arm rotation shaft **209**L is rotated counterclockwise in FIG. **9**. As a result, the working body **115**L moves away from the vertex **10***a* of the person's head **10**. Next, by rotating the second arm rotation shaft **210**L clockwise in FIG. **9** in the state where the first arm rotation shaft **209**L is fixed, the working body **115**L presses the person's head **10** with a predetermined pressing force.

According to the operation of extending and contracting the washing arm **12**L, the first arm rotation shaft **209**L is rotated in the state where the second arm rotation shaft **210**L is fixed and subsequently the second arm rotation shaft **210**L is rotated in the state where the first arm rotation shaft **209**L is fixed. However, the second arm rotation shaft **210**L may be rotated in the state where the first arm rotation shaft **209**L is fixed and subsequently the first arm rotation shaft **209**L may be rotated in the state where the second arm rotation shaft **210**L is fixed, in order to extend and contract the working body **115** with respect to the arm base **103**L. In the washing arm **12**L, by rotating both of the first arm rotation shaft **209**L and the second arm rotation shaft **210**L, the working body **115**L may be extended and contracted with respect to the arm base **103**L.

As described above, by rotating the first arm rotation shaft **209**L and the second arm rotation shaft **210**L, the washing arm **12**L can be extended and contracted with respect to the arm base **103**L. Thus, even when the person's head **10** changes in shape and size with change in the washed person, the person's head **10** can be reliably washed according to the shape and size of the person's head **10**.

In the five-joint link mechanisms **118**L in the first embodiment, the link length W1 of the first link **105**La is set to be equal to the link length W4 of the fourth link **105**Ld. However, depending on the design of the five-joint link mechanism, the link length W1 of the first link **105**La may be made different from the link length W4 of the fourth link **105**Ld.

In the five-joint link mechanisms **118**L, the sum of the distance W5 between the center of the first arm rotation shaft **209**L and the center of the second arm rotation shaft **210**L, and the link length W3 of the third link **105**Lc (W5+W3) is equal to the link length W2 of the second link **105**Lb. However, depending on the design of the five-joint link mechanism, the sum of the distance W5 between the center of the first arm rotation shaft **209**L and the center of the second arm rotation shaft **210**L, and the link length W3 of the third link **105**Lc (W5+W3) may be made different from the link length W2 of the second link **105**Lb.

In the five-joint link mechanisms **118**L in this embodiment, the position of the support shaft **211**L can be changed by controlling the rotation of the first arm rotation shaft **209**L and the second arm rotation shaft **210**L. However, when the second links **105**Lb and the fourth links **105**Ld, which are not fixed to the first arm rotation shaft **209**L and the second arm rotation shaft **210**L, are disposed in a line, and the support shaft **215**L, the support shaft **211**L, and the support shaft **216**L are disposed in a line, the links lack in balance, possibly causing a failure of the operation of the five-joint link mechanisms **118**L.

To prevent this, in the automatic head washing device **100** in this embodiment, the control unit **400** controls the rotation of the first arm rotation shaft **209**L and the second arm rotation shaft **210**L so as not to dispose the second links **105**Lb and the fourth links **105**Ld in a line, and not to dispose the support shaft **215**L, the support shaft **211**L, and the support shaft **216**L in a line.

Specifically, the control unit **400** controls the operation of the motor **221**L and the motor **228**L so as to confine the rotation of the first arm rotation shaft **209**L and the second arm rotation shaft **210**L within a range of an angle θ1 between the first link **105**La and the third link **105**Lc of 90±60 degrees. That is, the control unit **400** controls the operation of the motor **221**L and the motor **228**L so as to confine the angle θ1 between the first link **105**La and the third link **105**Lc (refer to FIG. **7**) within the range of 90±60 degrees.

By confining the angle θ1 between the first link **105**La and the third link **105**Lc within the range of 90±60 degrees in this manner, displacement of the working body **115**L supported by the support shaft **211**L with respect to the rotation of the first arm rotation shaft **209**L and the second arm rotation shaft **210**L can be increased, achieving the movement of the working body **115**L in a wide range.

In the first embodiment, the control unit **400** controls the motor **221**L and the motor **228**L to confine the angle θ1 between the first link **105**La and the third link **105**Lc within the range of 90±60 degrees, but the angle θ1 between the first link **105**La and the third link **105**Lc may be confined within the range of 90±60 degrees by use of other confining means such as a stopper or spring.

The right washing unit **12**R has the same configuration as the left washing unit **12**L. The right washing unit **12**R has a working body **115**R washing the person's head **10**, a first arm **105**R rotatably supporting the working body **115**R, an arm base **103**R to which the first arm **105**R is attached, a support shaft **104**R fixed to the arm base **103**R, and the pipe **111**R fixed to the arm base **103**R.

As shown in FIG. **2**, in the washing arm **12**R, the support shaft **104**R is rotatably coupled to the support column **102**R, and can rotate about the support shaft **104**R. That is, in the washing arm **12**R, the support shaft **104**R is rotatably attached to the bowl **101**, and can rotate about the support shaft **104**R.

A motor **201**R is disposed in the support column **102**R. A rotation output of the motor **201**R is transmitted to the support shaft **104**R via a gear **203**R attached to a motor rotation output shaft **202**R and a gear **204**R attached to the support shaft **104**R. The arm base **103**R fixed to the support shaft **104**R is driven by the rotation output transmitted from the motor **201**R to be rotatable about the support shaft **104**R. Driving of the motor **201**R is controlled by the control unit **400**.

The pipe **111**R has the same configuration as the pipe **111**L. The pipe **111**R has the plurality of nozzles **110** ejecting at least one of water, hot water, washing agent, and conditioner through the piping **219**, is attached to the arm base **103**R, and can rotate about the support shaft **104**R together with the arm base **103**R.

The working body **115**R has the same configuration as the working body **115**L. The working body **115**R includes a second arm **106**R rotatably supported by the first arm **105**R through a support shaft **211**R, third arms **107**R and **108**R

rotatably supported by the second arm **106**R through support shafts **213**R and **214**R, respectively, and a housing **116**R surrounding the second arm **106**R and the third arms **107**R and **108**R.

An elastic body such as a spring is provided between the second arm **106**R and the first arm **105**R to hold the second arm **106**R at a predetermined position with respect to the first arm **105**R. Elastic bodies such as springs are provided between the third arm **107**R and the second arm **106**R and between the third arm **108**R and the second arm **106**R to hold the third arms **107**R and **108**R at respective predetermined positions with respect to the second arm **106**R.

The plurality of contacts **109** that make contact with the person's head **10** supported by the head support **11** are attached to each of the third arms **107**R and **108**R. The contact units each having the plurality of contacts **109** at its front ends are rotatably supported by each of the third arms **107**R and **108**R, thereby swingably attaching the plurality of contacts **109** to each of the third arms **107**R and **108**R.

The first arm **105**R has the same configuration as the first arm **105**L. The first arm **105**R includes a first arm rotation shaft **209**R and a second arm rotation shaft **210**R that are independently rotated, and the first arm rotation shaft **209**R and the second arm rotation shaft **210**R each are rotatably held by the arm base **103**R. The rotation of the first arm rotation shaft **209**R and the second arm rotation shaft **210**R is controlled by the control unit **400**.

As shown in FIG. **12** described later, the first arm **105**R includes two five-joint link mechanisms **118**R and the support shaft **211**R. The support shaft **211**R couples the two five-joint link mechanisms **118**R to each other and rotatably supports the working body **115**R.

The five-joint link mechanisms **118**R each include a first link **105**Ra having one end fixed to the first arm rotation shaft **209**R, a second link **105**Rb having one end rotatably connected to the other end of the first link **105**Ra through a support shaft **215**R, a third link **105**Rc having one end fixed to the second arm rotation shaft **210**R, and a fourth link **105**Rd having one end rotatably connected to the other end of the third link **105**Rc through a support shaft **216**R. In the five-joint link mechanisms **111**R in this embodiment, the other end of the second link **105**Rb is rotatably connected to the other end of the fourth link **105**Rd through the support shaft **211**R.

In the first arm **105**R, the first arm rotation shaft **209**R rotates to rotate the first links **105**Ra, and the second arm rotation shaft **210**R rotates to rotate the second links **105**Rb. In the washing unit **12**R, the first links **105**Ra and the second links **105**Rb of the first arm **105**R rotate, thereby moving the support shaft **211**R with respect to the arm base **103**R and moving the working body **115**R with respect to the arm base **103**R.

The operation of the washing arms **12**L and **12**R will be described below with reference to FIG. **12**.

FIG. **12** is a view showing the operation of the washing arms of the automatic head washing device in accordance with the first embodiment. In FIG. **12**, the contacts **109** are covered with a cover **117**. The washing arms **12**L and **12**R are controlled by the control unit **400** to perform a pressing operation, an extending and contracting operation, a swinging operation, and a rubbing operation.

The pressing operation of the washing arms **12**L and **12**R refers to the operation of rotating the second arm rotation shafts **210**L and **210**R of the first arms **105**L and **105**R in the directions of an arrow A1 in FIG. **12** to move the working bodies **115**L and **115**R to be closer to the person's head **10** supported by the head support **11** (pressing direction) or to be away from the person's head **10** (releasing direction).

The extending and contracting operation of the washing arms **12**L and **12**R refers to the operation of rotating the first arm rotation shafts **209**L and **209**R and the second arm rotation shafts **210**L and **210**R of the first arms **105**L and **105**R to move the working bodies **115**L and **105**R to be away from the arm bases **103**L and **103**R, respectively, in the extending direction or to be closer to the arm bases **103**L and **103**R, respectively, in the contracting direction, the extending and contracting directions being directions represented by an arrow A2 in FIG. **12**.

The swinging operation of the washing arms **12**L and **12**R refers to the operation of rotating the support shafts **104**L and **104**R of the first arms **105**L and **105**R to rotate the washing arms **12**L and **12**R about the support shafts **104**L and **104**R, respectively, in the directions of an arrow A3 in FIG. **12**, thereby moving the working bodies **115**L and **115** in the forward and rearward direction of the person's head **10**.

The rubbing operation of the washing arms **12**L and **12**R refers to the operation of rotating the motor **301**L disposed in the housings **116**L and **116**R of the working bodies **115**L and **115**R to rotate the contacts **109** of the working body **115**L in directions of an arrow A4 in FIG. **12**, thereby causing the contacts **109** to swing.

In the automatic head washing device **100**, the pressing operation, the extending and contracting operation, the swinging operation, and the rubbing operation of the washing arms **12**L and **12**R are performed independently or in cooperation under control of the control unit **400** to wash the person's head **10**. In washing the person's head **10**, the control unit **400** controls the operations of the water supplying unit, the washing agent supplying unit, and the conditioner supplying unit.

The automatic head washing device **100** in this embodiment is a device automatically washing the person's head **10**, and can be also used as an automatic head care device automatically massaging the person's head **10** with the contacts **109** while water, shampoo, or so on is not ejected from the nozzles **110**.

FIG. **13** is a flow chart showing a washing method of the automatic head washing device in accordance with the first embodiment. As shown in FIG. **13**, when the automatic head washing device **100** washes the person's head **10**, first, the washing arms **12**L and **12**R are located in the initial state, and the head **10** of the washed person is inserted into the bowl **101** and placed on the head support **11**. Then, the operator of the automatic head washing device **100** or the washed person inputs the shape and size of the head **10** of the washed person (Step S**1**). The automatic head washing device **100** is provided with an input device such as a keyboard inputting the shape and size of the head **10** such that the information from the input device is inputted to the control unit **400**.

Then, the washing arms **12**L and **12**R are pressed in the pressing direction, bringing the working bodies **115**L and **115**R close to and into contact with the head **10** of the washed person (Step S**2**). Specifically, in the state where the first arm rotation shafts **209**L and **209**R of the washing arms **12**L and **12**R are fixed, the second arm rotation shafts **210**L and **210**R are rotated to move the working bodies **115**L and **115**R toward the head support **11**, thereby bringing the working bodies **115**L and **115**R into contact with the head **10** of the washed person.

Next, the washing arms **12**L and **12**R are extended or contracted based on the shape and size of the head **10**, which are inputted in Step S**1**, to move the working bodies **115**L and **115**R to respective proper positions (Step S**3**). The extending

or contracting operation of the washing arms **12**L and **12**R is performed by controlling the rotation of the first arm rotation shafts **209**L and **209**R and the second arm rotation shafts **210**L and **210**R.

The extending and contracting operation of the washing arms **12**L and **12**R is performed by rotating the first arm rotation shaft **209**L and subsequently rotating the second arm rotation shaft **210**L, or by rotating the second arm rotation shaft **210**L and subsequently rotating the first arm rotation shaft **209**L. The first arm rotation shaft **209**L and the second arm rotation shaft **210**L may be simultaneously rotated to perform the extending and contracting operation.

In the automatic head washing device **100**, the first arms **105**L and **105**R include respective pressure sensors detecting the pressing force of the working bodies **115**L and **115**R onto the person's head **10**, respectively. By simultaneously rotating the first arm rotation shaft **209**L and the second arm rotation shaft **210**L based on the pressing forces detected by the pressure sensors, the washing arms **12**L and **12**R can be extended or contracted with a predetermined pressing force.

After the working bodies **115**L and **115**R are moved to the proper positions with respect to the head **10** of the washed person in Step S**3**, water, hot water, or washing agent is ejected from the nozzles **110** to the head **10** of the washed person (Step S**4**).

Then, the rubbing operation and the swinging operation of the washing arms **12**L and **12**R are performed to wash the head **10** of the washed person (Step S**5**). The head **10** of the washed person is washed by rotating and swinging the contacts **109** provided on the working body **115**L of the washing arms **12**L and **12**R. The entire head **10** of the washed person is washed by moving the washing arms **12**L and **12**R in the forward and rearward direction of the head **10** of the washed person.

The swinging operation of the washing arms **12**L and **12**R is not limited to this, and may be performed by moving the washing arm **12**L and the washing arm **12**R in the forward and rearward direction of the head **10** such that the arms are aligned in the forward and rearward direction of the head **10** of the washed person. Alternatively, the swinging operation of the washing arms **12**L and **12**R can be performed by repeating the operation of moving the washing arm **12**L from the front side to the rear side of the head **10** and moving the washing arm **12**R from the rear side to the front side of the head **10**, and the operation of moving the washing arm **12**L from the rear side to the front side of the head **10** and moving the washing arm **12**R from the front side to the rear side of the head **10**.

After the rubbing operation and the swinging operation of the washing arms **12**L and **12**R are performed to wash the head **10** of the washed person in Step S**5**, water or hot water is ejected from the nozzles **110** to the head **10** of the washed person to rinse the head **10** of the washed person (Step S**6**). Following the rinsing of the head **10** of the washed person in Step S**6**, the rubbing operation and the swinging operation of washing arms **12**L and **12**R are stopped (Step S**7**).

Then, the washing arms **12**L and **12**R are pressed in the releasing direction to separate the working bodies **115**L and **115**R from the head **10** of the washed person (Step S**8**). In the state where the first arm rotation shafts **209**L and **209**R of the washing arms **12**L and **12**R are fixed, the second arm rotation shafts **210**L and **210**R are rotated so as to move the working bodies **115**L and **115**R away from the head support **11**, thereby separating the working bodies **115**L and **115**R from the head **10** of the washed person. The washing arms **12**L and **12**R are returned to the initial state to finish washing of the head **10** of the washed person. Conditioner is ejected from the nozzles **110** to the head **10** of the washed person as needed.

As described above, the automatic head washing device **100** in accordance with the first embodiment includes the first arm rotation shafts **209**L and **209**R and the second arm rotation shafts **210**L and **210**R, which are independently rotated, the first links **105**La and **105**Ra fixed to the first arm rotation shafts **209**L and **210**R, respectively, the second links **105**Lb and **105**Rb rotatably connected to the first links **105**La and **105**Ra, respectively, the third links **105**Lc and **105**Rc fixed to the second arm rotation shafts **210**L and **210**R, respectively, the fourth links **105**Ld and **105**Rd rotatably connected to the third links **105**Lc and **105**Rc, respectively, the support shafts **211**L and **211**R rotatably connecting the second links **105**Lb and **105**Rb to the fourth links **105**Ld and **105**Rd, respectively, the working bodies **115**L and **115**R rotatably supported by the support shafts **211**L and **211**R, respectively, and the control unit **400** controlling the rotation of the first arm rotation shafts **209**L and **209**R and the second arm rotation shafts **210**L and **210**R. With such a configuration, even when the person's head **10** changes in shape and size with change in the washed person, the person's head **10** can be reliably washed according to the shape of the person's head **10**.

The control unit **400** can control the rotation of the first arm rotation shafts **209**L and **209**R and the second arm rotation shafts **210**L and **210**R such that the working bodies **115**L and **115**R of the washing arms **12**L and **12**R can be extended and contracted with respect to the arm bases **103**L and **103**R, respectively. With this configuration, the person's head **10** can be washed more reliably.

The automatic head washing device **100** may be provided with a current detection unit such as a current sensor detecting a current value of the motor **228**L that rotates the second arm rotation shafts **210**L and **210**R. The control unit **400** can calculate a force applied to the motor **228**L on the basis of a change in the current value of the motor **228**, which is detected by the current detection unit.

For example, when the person's head **10** supported by the head support **11** moves in the state where the working bodies **115**L and **115**R are in contact with the person's head **10**, the force to raise the working bodies **115**L and **115**R according to the motion of the person's head **10** is transmitted to the motor **228**L through the fourth link **105**Ld, the third link **105**Lc, the second arm rotation shaft **210**L, and the second conversion mechanism. This is due to that the first conversion mechanism **227**L is irreversible. Accordingly, the force applied to the motor **228**L can be calculated based on the change in the current value of the motor **228** by use of the first conversion mechanism **227**L to easily measure the force to raise the working bodies **115**L and **115**R.

Assuming that the washed person attempts to move the head **10** from the head support **11** to pull the head out of the bowl **101** while the automatic head washing device **100** is washing the person's head **10**. In this case, since the force to raise the working bodies **115**L and **115**R according to the motion of the person's head **10** can be absorbed by the reversible second conversion mechanism, the head **10** can be pulled out of the automatic head washing device **100**.

Second Embodiment

Next, an automatic head washing device in accordance with a second embodiment of the present invention will be described. Only differences between the automatic head washing device in accordance with the second embodiment of the present invention and the automatic head washing device **100** in accordance with the first embodiment will be

described. The same constituents as those in the automatic head washing device **100** in accordance with the first embodiment are not described.

FIG. **14**A and FIG. **14**B are is views showing the operation of washing arms of the automatic head washing device in accordance with the second embodiment of the present invention.

As shown in FIG. **14**A and FIG. **14**B, the automatic head washing device in accordance with the second embodiment includes a distance sensor **120** detecting a distance between the working bodies **115**L and **115**R in each of the working bodies **115**L and **115**R of the washing arms **12**L and **12**R. In the second embodiment, the control unit **400** controls the operation of the washing arms **12**L and **12**R on the basis of the distance between the working bodies **115**L and **115**R, which is detected by the distance sensor **120**, the head **10** of the washed person can be washed while preventing the working bodies **115**L and **115**R from interfering with each other.

Third Embodiment

Next, an automatic head washing device in accordance with a third embodiment of the present invention will be described. Only differences between the automatic head washing device in accordance with the third embodiment of the present invention and the automatic head washing device **100** in accordance with the first embodiment will be described. The same constituents as those in the automatic head washing device **100** in accordance with the first embodiment are not described.

FIG. **15** is a view showing the operation of washing arms of the automatic head washing device in accordance with the third embodiment of the present invention. The automatic head washing device in accordance with the third embodiment has the same configuration as the automatic head washing device **100**.

In the automatic head washing device in accordance with the third embodiment, in washing the vertex **10***a* of the head **10** of the washed person, the control unit **400** controls the washing arms **12**L and **12**R such that, in the state where one washing arm **12**R is separated from the head **10** as shown in FIG. **15**, the working body **115**L of the other washing arm **12**L is extended with respect to the arm base **103**L while keeping the contacts **109** in contact with the head **10**.

Through such control, with the working body **115**L of the other washing arm **12**L being extended with respect to the arm base **103**L, the rubbing operation and the swinging operation of the washing arm **12**L are performed to wash the head **10** of the washed person. This can reliably wash the vertex **10***a* of the head **10** of the washed person.

In the description of the automatic head washing device in accordance with the third embodiment, the rubbing operation and the swinging operation are performed by extending the other washing arm **12**L in the state where the working body **115**R of the one washing arm **12**R is separated from the head **10**. However, the rubbing operation and the swinging operation may be performed by extending the other washing arm **12**L in the state where the working body **115**R of the one washing arm **12**R is in contact with the head **10** to perform the rubbing operation and the swinging operation.

A reason for which such control is effective will be described. For example, supposing that the swinging operation of the washing arms **12**L and **12**R is performed by repeating the operation of moving the washing arm **12**L from the front side to the rear side of the head **10** and moving the washing arm **12**R from the rear side to the front side of the head **10** and the operation of moving the washing arm **12**L from the rear side to the front side of the head **10** and moving the washing arm **12**R from the front side to the rear side of the head **10**, in the state where the washing arm **12**L is extended. In this case, when the washing arms **12**L and **12**R are aligned in the forward and rearward direction of the head **10** of the washed person, both of the washing arms **12**L and **12**R may interfere with each other. Accordingly, by controlling to extend or contract only one of the washing arms **12**L and **12**R, for example, in the vicinity of the vertex **10***a* of the head **10** of the washed person, the head **10** of the washed person can be washed while preventing interference between the washing arms **12**L and **12**R.

The operation of the washing arms **12**L and **12**R can be controlled to wash the head **10** of the washed person so as to allow the washing arms **12**L and **12**R to perform the rubbing operation and the swinging operation while causing the arms **12**L and **12**R to be extended or contracted. In this manner, when both of the washing arms **12**L and **12**R perform the swinging operation while being aligned in the forward and rearward direction of the head **10** of the washed person, it is preferable to keep the distance between the working bodies **115**L and **115**R of the washing arms **12**L and **12**R uniform.

Further, the operation of the washing arms **12**L and **12**R can be controlled to wash the head **10** of the washed person so as to allow the washing arms **12**L and **12**R to perform the rubbing operation and the swinging operation while causing one of the washing arms **12**L and **12**R to be extended or contracted.

Fourth Embodiment

Next, an automatic head washing device in accordance with a fourth embodiment of the present invention will be described. Only differences between the automatic head washing device in accordance with the fourth embodiment of the present invention and the automatic head washing device **100** in accordance with the first embodiment will be described. The same constituents as those in the automatic head washing device **100** in accordance with the first embodiment are not described.

FIG. **16** is a view showing a change in the position of the working body with the rotation of the first link in the extending direction of the washing arm. FIG. **16** and FIG. **17** described later schematically show the working body **115**L, the first arm **105**L, and the arm base **103**L of the washing arm **12**L. In this first arm **105**L, the link length of the second link **105**Lb is equal to the link length of the third link **105**Lc, and the link length of the second link **105**Lb is longer than the link length of the first link **105**La.

In the washing arm **12**L located as represented by solid lines in FIG. **16**, when the first arm rotation shaft **209**L is rotated in the direction of an arrow B1 in the state where the second arm rotation shaft **210**L is fixed, the washing arm **12**L moves to the position represented by chain double-dashed lines in FIG. **16** to extend the washing arm **12**L. When the second arm rotation shaft **210**L is rotated by a predetermined angle in the direction of the arrow B1, the fourth links **105**Ld connected to the second links **105**Lb rotate by a predetermined angle in the direction of an arrow B2 using the support shaft **216** as a starting point. As a result, the support shaft **211**L moves away from the arm base **103**L, and the working body **115**L supported by the support shaft **211**L also moves away from the arm base **103**L. Specifically, the support shaft **211**L moves with respect to the arm base **103**L by a predetermined amount in the direction of an arrow B3, which is parallel to the non-deformed second link **105**Lb, and the working body **115**L moves with respect to the arm base **103**L

by a predetermined amount in the direction of the arrow B3. In this case, the support shaft **211**L moves orthogonal to the non-deformed second link **105**Lb by a predetermined amount in the direction of an arrow B4, and the working body **115**L moves by a predetermined amount in the direction of the arrow B4. In the state where the working body **115**L is in contact with the head **10** of the washed person and the second arm rotation shaft **210**L is fixed, when the first arm rotation shaft **209**L is rotated in the direction of the arrow B1, the pressing force of the working body **115**L onto the head **10** increases with the extending operation of the washing arm **12**L.

FIG. **17** is a view showing a change in the working body with the rotation of the first link in the contracting direction of the washing arm. In the washing arm **12**L located as represented by solid lines in FIG. **17**, when the first arm rotation shaft **209**L is rotated in the direction of an arrow B5 in the state where the second arm rotation shaft **210**L is fixed, the washing arm **12**L moves to the position represented by chain double-dashed lines in FIG. **17** and is contracted. When the second arm rotation shaft **210**L is rotated by a predetermined angle in the direction of the arrow B5, the fourth links **105**Ld connected to the second links **105**Lb rotates by a predetermined angle in the direction of an arrow B6 using the support shaft **216** as a starting point. As a result, the support shaft **211**L moves closer to the arm base **103**L, and the working body **115**L supported by the support shaft **211**L also moves closer to the arm base **103**L. Specifically, the support shaft **211**L moves by a predetermined amount with respect to the arm base **103**L in the direction of an arrow B7, which is parallel to the non-deformed second link **105**Lb, and the working body **115**L moves with respect to the arm base **103**L by a predetermined amount in the direction of the arrow B7. At this time, the support shaft **211**L moves orthogonal to the non-deformed second link **105**Lb by a predetermined amount in the direction of an arrow B8, and the working body **115**L moves by a predetermined amount in the direction of the arrow B8. In the state where the working body **115**L is in contact with the head **10** of the washed person and the second arm rotation shaft **210**L is fixed, when the first arm rotation shaft **209**L is rotated in the direction of the arrow B5, the pressing force of the working body **115**L onto the head **10** decreases with the contracting operation of the washing arm **12**L.

In the automatic head washing device **100** in each of the embodiments, in extending and contracting the washing arm **12**L, there is performed the operation of rotating the first arm rotation shaft **209**L in the state where the second arm rotation shaft **210**L is fixed and subsequently rotating the second arm rotation shaft **210**L in the state where the first arm rotation shaft **209**L is fixed, or there is performed the operation of rotating the first arm rotation shaft **209**L on the basis of the pressing force of the working body **115**L onto the head **10**, the pressing force detected by the pressure sensor. However in the automatic head washing device in accordance with the fourth embodiment, the first arm rotation shaft **209**L is rotated by a predetermined amount on the basis of the rotational angle of the second arm rotation shaft **210**L so as to make the pressing force of the working body **115**L uniform.

FIG. **18** is a block diagram showing configurations of a pressing force control unit and an extension/contraction length control unit of the automatic head washing device in accordance with the fourth embodiment. FIG. **18** shows control of only the washing arm **12**L, but the washing arm **12**R is controlled in the same manner.

As shown in FIG. **18**, the control unit **400** has a pressing force control unit **401** controlling the pressing force of the working body **115**L onto the head **10** of the washed person, and an extension/contraction length control unit **402** controlling an extension/contraction length of the washing arm **12**L. The pressing force control unit **401** has at least a comparator **411**, a stabilizing compensator **412**, a comparator **413**, and a position controller **414**. The extension/contraction length control unit **402** has a comparator **421** and a position controller **422**.

In the automatic head washing device in accordance with the fourth embodiment, the washing arm **12**L is provided with a rotational sensor **510** detecting the rotational angle of the second arm rotation shaft **210**L. The rotational angle of the second arm rotation shaft **210**L, which is detected by the rotational sensor **510**, is sent to the comparator **413**.

The washing arm **12**L is provided with a pressure sensor **511** detecting the pressing force of the working body **115**L onto the head **10** of the washed person. The pressing force of the working body **115**L onto the head **10**, which is detected by the pressure sensor **511**, is sent to the comparator **411**.

The comparator **411** compares a pressing force command value outputted from a pressing force command value output section provided in the control unit **400** with the pressing force of the working body **115**L onto the head **10**, which is detected by the pressure sensor **511**, to calculate an error between the both values. An error signal is sent to the comparator **413** via the stabilizing compensator **412**. The stabilizing compensator **412** is formed of an integrator to stabilize a control system.

The comparator **413** compares a signal of the command value sent from the stabilizing compensator **412** with a signal of the rotational angle of the second arm rotation shaft **210**L, which is detected by the rotational sensor **510**, to calculate an error between the both signals. An error signal is sent to the motor **228**L, which rotates the second arm rotation shaft **210**L, via the position controller **414** controlling the rotational position of the second arm rotation shaft **210**L. In the washing arm **12**L, the control unit **400** controls the motor **228**L based on the error signal to allow the working body **115**L to apply a predetermined pressing force according to the pressing force command value.

In the automatic head washing device in accordance with the fourth embodiment, the washing arm **12**L is provided with a rotational sensor **512** detecting the rotational angle of the first arm rotation shaft **209**L. The rotational angle of the first arm rotation shaft **209**L, which is detected by the rotational sensor **512**, is sent to the comparator **421**.

The comparator **421** compares an extension/contraction length command value outputted from an extension/contraction length command value output section provided in the control unit **400** with the rotational angle of the first arm rotation shaft **209**L, which is detected by the rotational sensor **512**, to calculate an error between the both values. An error signal is sent to the motor **221**L, which rotates the first arm rotation shaft **209**L, via the position controller **422** controlling the rotational position of the first arm rotation shaft. The control unit **400** controls the motor **221**L based on the error signal, thereby allowing the washing arm **12**L to be extended/contracted with a predetermined extension/contraction length according to the extension/contraction length command value.

In the automatic head washing device in accordance with the fourth embodiment, the pressing force control unit **401** of the control unit **400** includes a non-interfering compensation unit **430** executing compensation processing of suppressing variation in the pressing force of the working body **115** onto the head **10**. The non-interfering compensation unit **430** has a non-interfering compensator **431** and an adder **432**.

The rotational angle of the first arm rotation shaft **209**L, which is detected by the rotational sensor **512**, is sent to the non-interfering compensator **431**. According to the rotational angle of the first arm rotation shaft **209**L, which is detected by the rotational sensor **512**, the non-interfering compensator **431** executes the compensation processing of the command value sent from the stabilizing compensator **412**. The compensation processing is executed using information previously stored in a storage unit of the control unit **400**, which corresponds to the rotational angle of the first arm rotation shaft **209**L.

The storage unit of the control unit **400** includes a table in which the rotational angle of the second arm rotation shaft **210**L is recorded. The rotational angle of the second arm rotation shaft **210**L, which is recorded in the storage unit of the control unit **400**, is the rotational angle of the second arm rotation shaft **210**L, which makes the pressing force of the working body **115**L supported by the support shaft **211**L onto the head **10** uniform when the first arm rotation shaft **209**L of the washing arm **12**L is rotated by a predetermined angle.

When the first arm rotation shaft **209**L is rotated by the predetermined angle to perform the extending operation of the washing arm **12**L, the rotational angle of the first arm rotation shaft **209**L, which is detected by the rotational sensor **512**, is inputted to the non-interfering compensator **431**. Then, the rotational angle of the second arm rotation shaft **210**L, which makes the pressing force of the working body **115**L onto the head **10** uniform, is calculated based on the rotational angle of the first arm rotation shaft **209**L by using the above-mentioned table, and the calculated rotational angle is outputted to the adder **432**.

The adder **432** is provided between the stabilizing compensator **412** and the comparator **413**. The adder **432** adds a value outputted from the non-interfering compensator **431** to the command value sent from the stabilizing compensator **412**. The command value thus corrected is sent to the comparator **413**. Then, the rotation of the second arm rotation shaft **210**L is controlled based on the comparison result of the comparator **413** via the position controller **414**. In this manner, the washing arm **12**L can be extended and contracted with a uniform pressing force.

As described above, in the automatic head washing device in accordance with the fourth embodiment, when the working body **115**L is extended and contracted with respect to the arm base **103**L, the control unit **400** controls the rotation of the second arm rotation shaft **210**L on the basis of the rotational angle of the first arm rotation shaft **209**L so as to make the pressing force of the working body **115**L onto the head **10** of the washed person uniform.

The above-mentioned rotational control is feedforward control. For this reason, in the fourth embodiment, as compared to the case using feedback control, variation in the pressing force of the working body **115**L onto the head **10** can be further suppressed, comfortably washing the person's head **10**. According to feedback control used herein, when the working body **115**L is extended and contracted with respect to the arm base **103**L, the rotation of the second arm rotation shaft **209**L is controlled based on the pressing force detected by the pressure sensor **511** after rotation of the first arm rotation shaft **209**L so as to make the pressing force uniform. According to feedforward control used herein, the rotation of the second arm rotation shaft **210**L is controlled based on the rotational angle of the first arm rotation shaft **209**L, which is outputted from the rotational sensor **512** after rotation of the first arm rotation shaft **209**L, so as to make the pressing force uniform.

In the automatic head control device in the fourth embodiment, when the washing arms **12**L and **12**R are extended and contracted, the control unit **400** performs feedforward control as described above. However, feedforward control and feedback control can be used in combination by performing feedforward control and subsequently performing feedback control to control the rotation of the second arm rotation shaft **209**L on the basis of the pressing force detected by the pressure sensor **511**.

Fifth Embodiment

Next, an automatic head washing device in accordance with a fifth embodiment of the present invention will be described. Only differences between the automatic head washing device in accordance with the fifth embodiment of the present invention and the automatic head washing device **100** in accordance with the first embodiment will be described. The same constituents as those in the automatic head washing device **100** in accordance with the first embodiment are not described.

FIG. **19** is a side partial cutout view showing the washing arm of the automatic head washing device in accordance with the fifth embodiment of the present invention. As shown in FIG. **19**, the automatic head washing device in accordance with the fifth embodiment is provided with an extendable motor **231**L as the first actuator rotating the first arm rotation shaft **209**L in the automatic head washing device **100**. The motor **231**L is disposed in the support shaft **104**L of the washing arm **12**L such that an output shaft **232**L matches the central axis of the support shaft **104**L. The output shaft **232**L can move parallel to the central axis of the support shaft **104**L.

In the automatic head washing device in accordance with the fifth embodiment, a first conversion mechanism **237**L converting the motion of the output shaft **232**L of the motor **231**L into the rotation of the first arm rotation shaft **209**L is disposed in the arm base **103**L. The first conversion mechanism **237**L is configured of a rod member **233**L that is fixed to the first arm rotation shaft **209**L and has one end engaged with the output shaft of the motor **231**L, and a spring **234**L fixed between the other end of the rod member **233**L and the arm base **103**L in a compressed state.

In the first conversion mechanism **237**L, when the output shaft **232**L of the motor **231**L extends, the first arm rotation shaft **209**L rotates via the rod member **233**L counterclockwise in FIG. **19**. When the output shaft **232**L of the motor **231**L contracts, the first arm rotation shaft **209**L rotates via the rod member **233**L clockwise in FIG. **19**. By rotating the first arm rotation shaft **209**L, the motion of the output shaft **232**L of the motor **231**L is converted into the rotation of the first arm rotation shaft **209**L. Driving of the motor **231**L is controlled by the control unit **400**.

The motor **231**L is disposed in the support shaft **104**L such that the output shaft **232**L extends parallel to the support shaft **104**L and thus, need not be disposed in the arm base **103**L. Accordingly, in the fourth embodiment, as compared to the case where the motor **231**L is disposed in the arm base **103**L, the arm base **103**L can be made more compact.

The present invention is not limited to the illustrated embodiments, and as a matter of course, may be variously improved and changed in design so as not to deviate from the subject matter of the present invention.

INDUSTRIAL APPLICABILITY

An automatic head care device and an automatic head care method according to the present invention can be widely used

in the medical field and in the industry of beauty care in which a person's head is being cared, which is useful.

DESCRIPTION OF REFERENCE SYMBOLS

10 head
11 head support
12, **12**L, **12**R washing arm
100 automatic head washing device
101 bowl
102L, **102**R support column
103L, **103**R arm base
104L, **104**R, **211**L, **211**R, **215**L, **215**R, **216**L, **216**R support shaft
105L, **105**R first arm
105 La, **105**Ra first link
105 Lb, **105**Rb second link
105 Lc, **105**Rc third link
105 Ld, **105**Rd fourth link
109 contact
115L, **115**R working body
116L, **116**R housing
118L, **118**R five-joint link mechanism
201L, **201**R, **221**L, **228**L, **231**L, **301**L motor
209L, **209**R first arm rotation shaft
210L, **210**R second arm rotation shaft
222L, **232**L output shaft
227L, **237**L first conversion mechanism
223L worm
224L worm wheel
400 control unit

The invention claimed is:

1. An automatic head care device comprising:
a base having a head support supporting a person's head;
independently rotated first rotational driving shaft and second rotational driving shaft;
a first link having one end fixed to the first rotational driving shaft;
a second link having one end rotatably connected to another end of the first link;
a third link having one end fixed to the second rotational driving shaft;
a fourth link having one end rotatably connected to another end of the third link;
a working shaft rotatably connecting another end of the second link to another end of the fourth link;
a working body caring the person's head supported by the head support, the working body being rotatably supported by the working shaft; and
a control unit controlling rotation of the first rotational driving shaft and the second rotational driving shaft.

2. The automatic head care device according to claim **1**, wherein
the control unit rotates the first rotational driving shaft and the second rotational driving shaft to cause the working body to make contact with the person's head supported by the head support.

3. The automatic head care device according to claim **2**, further comprising:
an arm base rotatably holding the first rotational driving shaft and the second rotational driving shaft, the shafts being coupled to the working body; and
a support shaft fixed to the arm base, the support shaft being rotatably attached to the base, wherein
the control unit controls rotation of the first rotational driving shaft and the second rotational driving shaft to enable the working body to be extended and contracted with respect to the arm base.

4. The automatic head care device according to claim **3**, wherein
when the working body is extended and contracted with respect to the arm base, the control unit controls rotation of the second rotational driving shaft on the basis of a rotational angle of the first rotational driving shaft so as to make a pressing force of the working body onto the head uniform.

5. The automatic head care device according to claim **1**, wherein
a ratio of a link length of the first link to a link length of the fourth link is 1:1.

6. The automatic head care device according to claim **5**, wherein a ratio among the link length of the first link, a link length of the second link, a link length of the third link, and the link length of the fourth link is 1:4:3.5:1.

7. The automatic head care device according to any onc of claim **1**, further comprising:
a first actuator rotating the first rotational driving shaft; and
a second actuator rotating the second rotational driving shaft, wherein
the control unit controls operation of the first actuator and the second actuator so as to confine an angle between the first link and the third link within a range of 90±60 degrees.

8. The automatic head care device according to claim **7**, further comprising a first conversion mechanism converting motion of an output shaft of the first actuator into rotation of the first rotational driving shaft, wherein
the first actuator is disposed such that the output shaft extends parallel to the support shaft of the first actuator.

9. The automatic head care device according to claim **8**, wherein
the first conversion mechanism has a worm and a worm wheel converting rotation of the output shaft of the first actuator into rotation of the first rotational driving shaft.

10. The automatic head care device according to claim **7**, further comprising:
a current detection unit detecting a current value to drive the second actuator; and
a second conversion mechanism reversibly converting motion of an output shaft of the second actuator into rotation of the second rotational driving shaft, wherein
the control unit calculates a force applied to the second actuator on the basis of a change in the current value detected by the current detection unit.

11. The automatic head care device according to claim **3**, wherein
the working body is a working body washing a person's head, and
the control unit rotates the support shaft to cause the working body to swing in a forward and rearward direction of the person's head supported by the head support, thereby washing the person's head.

12. The automatic head care device according to claim **11**, further comprising a nozzle ejecting water or hot water to the person's head supported by the head support, wherein
the control unit causes the nozzle to eject water or hot water and the working body to swing, thereby washing the person's head.

13. An automatic head care method using an automatic head care device including: a base having a head support

supporting a person's head; independently rotated first rotational driving shaft and second rotational driving shaft; a first link having one end fixed to the first rotational driving shaft; a second link having one end rotatably connected to another end of the first link; a third link having one end fixed to the second rotational driving shaft; a fourth link having one end rotatably connected to another end of the third link; a working shaft rotatably connecting another end of the second link to another end of the fourth link; a working body rotatably supported by the working shaft; an arm base rotatably holding the first rotational driving shaft and the second rotational driving shaft; and a support shaft fixed to the arm base, the support shaft being rotatably attached to the base, the method comprising

controlling rotation of the first rotational driving shaft and the second rotational driving shaft to cause the working body to make contact with the person's head supported by the head support, thereby caring the person's head.

14. The automatic head care method according to claim **13**, further comprising

controlling rotation of the first rotational driving shaft and the second rotational driving shaft to cause the working body to be extended and contracted with respect to the arm base.

15. The automatic head care method according to claim **13**, wherein

the working body is a working body washing a person's head, and

the method further comprising

rotating the support shaft to cause the working body to swing in a forward and rearward direction of the person's head supported by the head support, thereby washing the person's head.

16. The automatic head care method according to claim **15**, further comprising

providing a nozzle ejecting water or hot water to the person's head supported by the head support; and

ejecting water or hot water from the nozzle and swinging the working body to wash the person's head.

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